9568

3160 Series
MRI Physiological Monitor

Field Service Manual

Invivo™

Invivo Corporation

3160 Series
MRI Physiological Monitor

Field Service Manual

Invivo Corporation
12601 Research Parkway
Orlando, FL 32826
1-800-331-3220
1-407-275-3220
www.invivocorp.com

Invivo™

Disclaimer:
The maintenance instructions and drawings contained in this Service Manual are subject to change without notice, and may not reflect the very latest configuration of the equipment.

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European Authorized Representative

Invivo UK, Ltd.
Halifax, West Yorkshire
United Kingdom

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EQUIPMENT CLASSIFICATION	
Classification according to IEC 60601-1	
According to the type of protection against electrical shock:	Class I equipment.
According to the degree of protection against electrical shock:	Type CF (defibrillator-proof) equipment.
According to the degree of protection against harmful ingress of water:	Ordinary equipment (enclosed equipment without protection against ingress of water).
According to the methods of sterilization or disinfection:	Non-sterilizable. Use of Liquid surface disinfectants only.
According to the mode of operation:	Continuous operation.
Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.	

PRECAUTIONS

GENERAL SERVICE PRECAUTIONS

Notes, Cautions and Warnings. The following is a description of the format and meaning of Notes, Cautions and Warnings that appear in the body of this manual:

a. **Notes.** Notes are text boxes which contain special operational information applicable to the step or procedure which they precede. The Note box contains no bordering lines. Notes are presented as shown below.

NOTE

This is a sample note.

b. **Cautions.** A Caution is a statement that alerts the user to the possibility of a problem with the device associated with its use or misuse. Cautions are bordered top and bottom with thick lines. Cautions are presented as shown below.

CAUTION

This is a sample caution.

(The ⚠ international symbol is used to indicate a Precautionary Alert.)

c. **Warnings.** A Warning is a statement that alerts the user to the possibility of injury, death or other adverse reactions associated with the use or misuse of the device. The Warning box is bordered top, bottom, left and right with thick lines. Warnings are presented as shown below.

WARNING

This is a sample warning (for an electrical shock hazard).

(The ⚠ international symbol is used to indicate an Electrical Shock Hazard, where applicable.)

NOTE

In addition to these precautions, cautions and warnings are also imbedded in the text of this manual on Page 2-2, Page 3-19, Page 3-11, Page 3-21, Page 3-8, Page 6-1, Page 6-5, Page 7-1, Page 7-5, Page 7-8, Page 7-11, Page 7-13, Page 7-14, Page 7-17, Page 9-1, Page 9-4, Page B-2, Page C-1, Page G-1, and Page G-4.

Obtain a thorough understanding of each of the following precautions before attempting to perform any assembly/disassembly or service procedure. Damage to the instrument or injury to yourself may result if these precautions, as well as common sense, are <u>not</u> applied.

Service to this product should only be performed by trained, qualified service personnel familiar with the operation and service documentation for this monitor.

Shock Hazard exists when this monitor is operated without the chassis cover. Use caution when working on units with power applied.

Always disconnect monitor from AC Main Power before performing service on internal assemblies.

Precautions

GENERAL SERVICE PRECAUTIONS (Continued)

The system may not conform to all performance specifications if stored or used outside the environmental specifications listed in Appendix D of this manual.

Due to the monitor's internal batteries, power may be present even when disconnected from the AS201 Power Adapter. When necessary, remove the internal batteries prior to performing service or shipping the system to the manufacturer for repair.

For continued protection against fire hazard, replace fuses with same type and rating only.

Always follow proper electrostatic discharge (ESD) procedures during component and assembly handling to prevent static discharge damage to sensitive parts.

Use only replacement parts specified in this manual; ensure that defective or worn parts are properly disposed of in accordance with local regulations.

When cleaning the unit, do not permit liquid to enter the case. When cleaning, use proper materials and ensure total dryness before powering up the monitor. Use care that cleaning fluids do not attack plastic or painted surfaces. Use care that wiping rags do not abrade the surfaces.

Assembly hardware has been secured with a thread locking agent. After several assembly/ disassembly cycles, a new locking agent will be required. (Use Loctite 42540 or similar type for use near PVC or acrylic plastics.)

In general, handle all Printed Circuit Boards by their edges. Oils, sweat, dirt, etc. can induce leakage paths in high impedance circuits which impede their operation. Such contamination will also promote corrosion of circuits yielding a long term reliability problem.

Avoid rough handling of all exposed chassis parts and DCU front panel overlay. These parts can be scratched causing obtrusive cosmetic defects.

Do not apply any unnecessary pressure to the screen area of the DCU. Severe pressure applied to this portion of the monitor could result in damage or failure of this screen.

All equipment not complying with IEC 60601-1 should be placed outside the patient environment. Only connect IEC 60601-1 compliant equipment to this monitor. To avoid potentially hazardous leakage currents, always check the summation of leakage currents when several items of equipment are interconnected.

This system is intended for use in the Magnetic Resonance Imaging (MRI) areas. Use only non-ferrous or non-magnetic replacement parts in the monitor.

Connect the AS201 Power Adapter only to a three-wire, grounded, hospital-grade receptacle. The three-conductor plug must be inserted into a properly wired three-wire receptacle; if a three-wire receptacle is not available, a qualified electrician must install one in accordance with the governing electrical code.

Do not under any circumstances remove the grounding conductor from the AS201 power plug.

Avoid use of electrical power extension cords. Electrical power extension cords may create a safety hazard by compromising the grounding integrity of the monitor.

This monitor and its listed accessories may be safely powered by the voltages 110-120/220-240 VAC having a frequency of 50 or 60 Hz.

If the integrity of the earth ground conductor of the AC mains power cable is in doubt, operate the monitor on internal battery power until proper earth ground connection is confirmed.

MRI SERVICE PRECAUTIONS

CAUTION

Federal law in the USA and Canada restricts this device to sale by, or on the order of, a licensed medical practitioner.

NOTE

Use only MRI compatible accessories and parts with this monitor.

This monitor is not intended for use in the presence of **FLAMMABLE ANESTHETICS**. **An explosion hazard exists.**

Never immerse the monitor in any fluid or attempt to clean it with liquid cleaning agents. **An electrical hazard exists.**

No repair should be undertaken or attempted by anyone not having a thorough understanding of the repair and safety assurance of patient monitors.

Always verify proper communication of the **3160 MRI Physiological Monitoring System** with the Remote Monitor prior to patient use.

MRI Magnet Room Placement. The **3160 MRI Physiological Monitoring System** is designed to be used in conjunction with a remote monitor. The **3160 MRI Physiological Monitoring System** is specially designed not to interfere with MRI operations and may be used inside the MRI Magnet Room in any location at or outside the 5000 (5,000 or less) Gauss (0.5T) Field Line of the MRI System, as measured from the center line of the MRI bore. Field strength variations in a particular MRI system may be due to manufacturer variability, future enhancements, etc. This variation may require moving the patient monitoring system away from the magnet if system abnormalities or malfunctions are observed. Prior to clinical use, the operator should be aware of the minimum distance from the MRI system for proper operation. If brought closer than the 5000 Gauss Field Line, the monitor failure and/or patient or user injury may result.

The **Remote Monitor** is also specifically designed not to interfere with MRI operations, and may be used in the Magnet Room at or outside the 1000 Gauss (0.1T) Field Line of the MRI System. If brought closer than the 1000 Gauss Field Line, monitor damage (failure to operate) may result.

Risk of RF current burn. Cables which become inadvertently looped during an MRI act as conductive lines for RF induced currents. When lead wires or other cables form conductive loop in contact with the patient's tissue, minor to severe burning can result.

Perform the following to minimize risk of RF current burn:

a. Place cables and lead wires neatly in straight alignment with no looping.

b. Keep the length of lead wires and patient cable within the bore to a minimum.

c. RF burn risk increases when multiple sensors/cables are in use. Such combinations are not recommended.

d. The high radio frequency (RF) power used in MR scanning poses an ever-present risk of excessive heat at the monitoring sites and, therefore, the risk of RF current burn. **Should power levels greater than the SAR of 4 w/kg peak (0.4 w/kg average) be used, the risk of patient burn greatly increases.** As a result, monitoring of ECG or Respiration (derived from ECG leads) at power levels of greater than 4 w/kg peak (0.4 w/kg average) is not recommended for the general patient population. Such monitoring should only be attempted on conscious patients with good temperature reflex so they may warn the operator of excessive heat at the monitoring sites.

MRI SERVICE PRECAUTIONS (Continued)

e. High RF Power may cause patient heating or burns. Use caution for scan times greater than 15 minutes. It is recommended that ECG electrode temperature be checked during scans greater than 15 minutes.

⚠ BATTERY PACK SERVICE PRECAUTIONS AND DISPOSAL ⚠

The WPU and DCU use the same battery packs (2 Ea.), Invivo P/N 9064. The charging of these packs is normally performed by an intelligent battery charger, which is internal to both the DCU and WPU. This charger provides the appropriate charge/discharge profile depending on battery capacity. It automatically turns ON/OFF, as required, to charge/discharge the battery packs. A constant current of 1.5A at 16.8V is provided to charge the battery pack as it becomes necessary. Invivo recommends removal of all batteries if the 3160 is not to be used for a period of longer than 3 days (72 hours).

WARNINGS:

- Stop using the battery if it exhibits abnormal heat, odor, color, deformation or is in an abnormal condition.
- If punctured or liquid leaks onto your skin or clothes, wash well with fresh water immediately.
- If liquid leaking from the battery gets into your eyes, do not rub your eyes. Wash them well with clean water and consult a doctor immediately.

CAUTIONS:

- Never heat the battery or throw into a fire. Keep the battery contacts away from metal objects.
- Replace only with INVIVO REF 9064.
- Store battery in a dry place, 0°C to 40°C.
- Dispose of properly.*
- Do not disassemble or incinerate.
- Charge before use.
- Batteries have life cycles, so if the time that the battery is powering the equipment becomes much shorter than usual, the battery life is at an end. Replace the battery with a new one.
- Remove a battery whose life cycle has expired from equipment immediately.
- If the terminals of the battery become dirty, wipe them with a dry cloth before using the battery.

*DISPOSAL IN EUROPE

The European Community (EC) has issued two directives: 91/157/EEC and 93/86/EEC. Each member country implements these independently. Thus, in each country the manufacturers, importers and users are responsible for the proper disposal or recycling of batteries.

*DISPOSAL IN THE U.S.

Lithium batteries are neither specifically listed nor exempted from the Federal Environmental Protection Agency (EPA) hazardous waste regulations, as conveyed by the Resources Conservation and Recovery Act (RCRA). The only metal of possible concern in the cell is the lithium metal that is not listed or characterized as a toxic hazardous waste. Significant amount of spent cells and batteries that are untreated and not fully discharged are considered reactive hazardous waste. Thus, hazardous waste of spent cells and batteries can be disposed after they are first neutralized through an approved secondary treatment prior to disposal (as required by U.S. Land Ban Restriction of the Hazardous and Solid Waste Amendments of 1984). Disposal of spent batteries should be performed by an authorized, professional disposal company, which has the knowledge in the requirements of the Federal, State and Local authorities regarding hazardous materials, transportation and waste disposal. In any case, it is recommended to contact the local EPA office.

MRI COMPATIBILITY

The Quadtrode® MRI ECG Electrode Pad, and ECG Patient Lead Wires and Cable, are compatible with Magnetic Resonance Imaging (MRI) Systems within the following guidelines:

- MRI systems with static magnetic field strengths up to 3.0 Tesla.
- Usable within the MRI system bore with Specific Absorption Ratios (SARs) up to 4.0 w/kg (peak). Use with higher SARs greatly increases the risk of patient burns.
- Non-magnetic materials are used in the construction of these assemblies.
- If scanned directly across the plane of the ECG electrode element, a slight image distortion may be seen at the skin surface where the electrode element is positioned.

USER RESPONSIBILITY

This product will perform in conformity with the description contained in the Operations Manual for the **3160 Series MRI Physiological Monitor** (Invivo Part Number 9569) and accompanying labels and/or inserts, when assembled, operated, maintained, and repaired in accordance with the instructions provided. Preventive maintenance should be performed on this equipment on a periodic basis as specified in Section 7: Page 7-2, paragraph 7.3 of this manual. Prior to servicing this product, completely familiarize yourself with the above Operations Manual and record all user selectable settings for re-installation after service/repair is complete. Operational quick checks (see Section 2: Page 2-3, paragraph 2.6) should be successfully performed on the monitor before each use.

A defective product should never be used. Parts that are broken, missing, plainly worn, distorted, or contaminated should be replaced immediately. Neither this product nor any of its parts should be repaired other than in strict accordance with written instructions provided by Invivo or altered without the prior written approval of Invivo. Should the troubleshooting procedures provided in Section 9 of this manual fail to correct the problem, contact Invivo for further guidance or to arrange for the shipment of defective equipment to Invivo for depot repair (see Appendix B). The user of the product shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, improper repair, damage, or alteration by anyone other than Invivo authorized service personnel.

Refer to the above Operations Manual for all applicable user maintenance requirements in the clinical environment.

This device is covered under one or more of the following U.S. Patents: 5,482,036; 5,490,505; 5,632,272; 5,685,299; 5,758,644; 5,769,785; 6,002,952; 6,036,642; 6,067,462; 6,206,830; 6,157,850; 6,277,081 and international equivalents. U.S.A. and international patents pending.

Possession or purchase of this device does not convey any express or implied license to use the device with replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

SECTION 1
INTRODUCTION

1.0 INTRODUCTION.

NOTE

This manual describes a fully configured system, and may include features and/or options that are not included in your system. For additional information, contact your local sales representative, or Invivo Customer Service (see Page 1-6, paragraph 1.5).

NOTE

Reference Section 4 for more detailed "Theory of Operation" for this equipment.

NOTE

Refer to the **3160 Series MRI Physiological Monitor Operations Manual** (Invivo P/N 9569) for general purpose operating instructions pertaining to this monitor.

1.1 General Description. The Model 3160 MRI Physiological Monitoring System is designed to assist clinicians in monitoring patient vital signs in the midst of the dynamic and evolving Magnetic Resonance environment. A combination of the latest wireless communication, radio frequency (RF) shielding, digital signal processing (DSP), and adaptable mounting technologies address the challenges associated with patient monitoring in the MRI area. Built on Invivo's strong heritage in MRI patient vital signs monitoring, the 3160 provides accurate, continuous, and reliable performance during all phases of MRI applications.

The standard 3160 configuration consists of wireless electrocardiogram (ECG), wireless pulse oximetry (SPO2), and Non-Invasive Blood Pressure (NIBP). Optional parameters include Invasive Blood Pressure (IBP), Temperature (TEMP), Respiration (RESP), End-Tidal CO2 (EtCO2) and Anesthetic Agents (EtCO2).

The 3160 system consists of the following components:

a. **Wireless Processing Unit.** The Wireless Processing Unit (WPU) houses the circuitry and hardware for support of the standard and optional patient monitoring parameters. The transceivers and antennas that support wireless communication with the ECG and SPO2 modules as well as the Display Control Unit are also part of the WPU. The unit is powered by an AC/DC AS201 power adapter during normal operation, or by two removable 9064 batteries that are recharged by the same power adapter. The batteries provide 8 hours of continuous operation.

b. **Patient Connection Unit.** The Patient Connection Unit (PCU) contains the connectors for all the non-wireless parameters (i.e. NIBP, EtCO2, etc.).

c. **Display Control Unit.** The WPU communicates to the Display Control Unit (DCU) via a bi-directional 2.4 GHz communication link. The large color LCD display, keypad, and recorder of the DCU form an easy-to-use user interface for display, control, and documentation of the system patient monitoring parameters.

d. **Wireless ECG Module.** The Wireless ECG (WECG) module communicates two leads of ECG simultaneously to the WPU. These two leads of ECG can be displayed at the DCU and are output from the WPU unit for interface to the MRI system cardiac gating input.

e. **Wireless SPO2 Module.** The Wireless SPO2 (WSPO2) communicates the SPO2 value and pulse waveform, and optional respiration value, to the WPU. The information is available for display at the DCU and the pulse data is output from the WPU for interface to the MRI system pulse peripheral gating input.

CAUTION

For continued patient safety and image integrity, use only those Invivo accessories and equipment specifically designated for MRI applications.

The **3160 Series MRI Physiological Monitor** includes the following Vital Sign Parameters:

- Dual Trace ECG
- Respiration
- Non-Invasive Blood Pressure
- SPO2
- EtCO2
- Invasive Blood Pressure
- Temperature
- Agents (with EtCO2)

1.1.1 System Parameters. The **3160 Series MRI Physiological Monitor System Parameters** allow simultaneous processing and display of up to five parameters, three waveforms and associated numeric values from each different parameter. All the Patient Information is clearly displayed on the Display Control Unit's (DCU) Flat Panel Display Screen.

1.1.2 User Interface. A simple to use interface has been developed to minimize operator learning time. On the DCU, there is a *Rotary Knob* (which detents from selection to selection) that is used to access the parameter menus, access the various setup features and finalize any changes to the setup of the monitor. Frequently used menus (such as **Alarms, Trends** and **Recorder**) have a *Control Key* which, when pressed, will open the associated menu. On the Wireless Processor Unit (WPU), the operator needs an external display and a keyboard to access the various features.

1.1.3 Versatility. With its diverse offering of vital sign parameters, the **3160 Series MRI Physiological Monitoring System** may be configured to meet the monitoring needs of a wide spectrum of patients from Neonate to Adults. Every available parameter may be easily accessed and adjusted to the unique needs, condition and situation of each patient.

1.2 Major Assemblies. (See Figure 1-1) The three major assemblies that comprise the **3160 Series MRI Physiological Monitoring System** are described in the following paragraphs.

1.2.1 Wireless Processor Unit (WPU). The WPU contains wireless transceivers, data acquisition and processing circuitry that communicate with the wireless Display Control Unit (DCU), ECG (WECG) module and SPO2 (WSPO2) module.

a. **Operating Environment.** The WPU is designed to operate at the 5,000 Gauss line in the generated RF field of an MRI system measured from the center line of the bore.

b. **Power Supply.** The AS201 Power Adapter is designed to operate on the floor at least 10 feet from a 1.5 Tesla unshielded MRI system (200 Gauss). When attached, the power adapter charges the WPU battery packs whether the WPU is operating or not.

c. **Battery Operation.** The WPU will operate at least eight (8) hours with EtCO2 and all optional devices running with NIBP performing automatic readings at five (5) minute intervals.

1.2.2 Patient Connection Unit (PCU). The physical patient connections for NIBP and the IBP, TEMP, EtCO2 and Anesthetic Agents options are located on the PCU. ECG, SPO2 and Respiration all use wireless technology to deliver their measurements to the WPU.

a. **Operating Environment.** The PCU is designed to operate at the 5,000 Gauss line in the generated RF field of an MRI system measured from the center line of the bore.

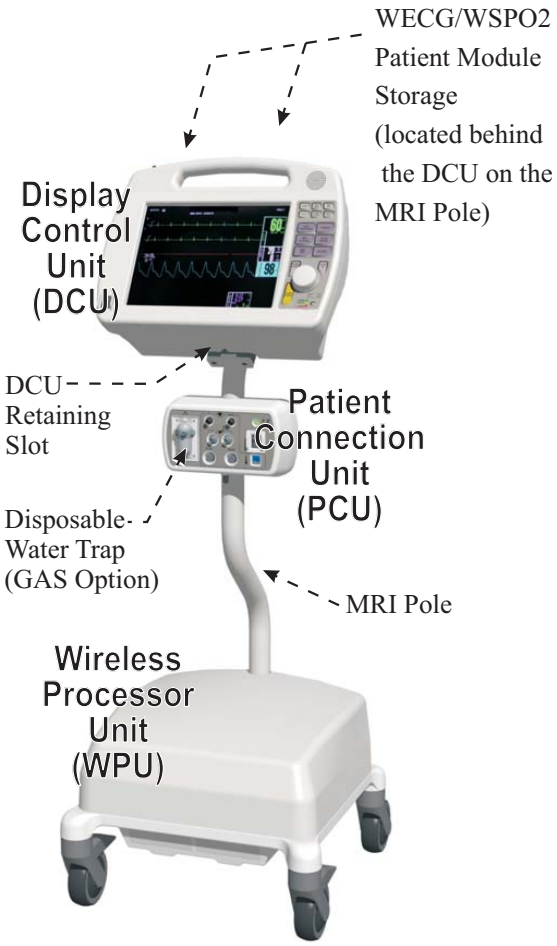

Figure 1-1 3160 Major Assemblies

b. **Monitoring.** The PCU contains the physical connections for the NIBP and, when installed, the optional IBP, TEMP, EtCO2 and Anesthetic Agents parameters. If a GAS is installed (EtCO2 or Anesthetic Agents), the PCU also contains a disposable water trap to prevent moisture contamination of the components.

1.2.3 Display Control Unit (DCU). The detachable DCU unit (normally mounted into a retaining slot at the top of the MRI pole) provides for control and display of the monitored parameters. Control of the Monitoring Features is provided through the use of a Rotary Knob; as the operator turns the Rotary Knob (either clockwise or counter clockwise), with each detent the next Menu-Select Icon (Vital Sign Numerical Display) will become highlighted (selected) and, when the appropriate display is selected, pressing the Rotary Knob will bring up the menu for that parameter. For control and adjustment of the operation and features, the Keypad contains three separate sets of pushbutton keys which contain both operational and menu-select keys.

1.3 Wireless Monitoring Capability. The **3160** monitor utilizes wireless radio technology for ECG and SPO2/RESP patient monitoring as described in the following paragraphs.

1.3.1 ECG Monitoring. (See Figure 1-2) ECG is monitored using a Wireless ECG (WECG) Telemetry Transmitter. The WECG Patient Module consists of a wireless transceiver to communicate with the WPU and convert the ECG signals into radio signals for transmission to the WPU. The module also receives information through the wireless link, converts the information to electrical signals and performs the commanded task (i.e. lead configuration change, scaling, etc.).

a. **Compatibility.** The Standard Wireless ECG Module supports the four ECG electrode placement used with the Quadtrode® (Invivo P/N 9303), Quadtrode® CV, Neonatal Quadtrode® and MRI ECG Patient Cable and Lead wires (Invivo P/N 9340) for display of Lead II.

b. **Visual Indicators.** The WECG module contains one (1) bi-color LED that indicates the status of the battery charge.

c. **Battery Life.** The WECG module will operate at least eight (8) hours on a fully charged battery.

Figure 1-2 WECG Telemetry Transmitter

1.3.2 SPO2 and Respiration Monitoring. (See Figure 1-3) SPO2 and Respiration are monitored using a Wireless SPO2 (WSPO2) Telemetry Transmitter. The WSPO2 Patient Module consists of a wireless transceiver to communicate with the WPU and convert the SPO2 and RESP pulse signals into radio signals for transmission to the WPU.

a. **Visual Indicators.** The WSPO2 module contains one (1) bi-color LED that indicates the status of the battery charge.

b. **Battery Life.** The WSPO2 module will operate at least eight (8) hours on a fully charged battery.

1.4 How to Use This Manual. Overall servicing of this product is divided into two distinct sets of maintenance activities: Field Service Replacement and Depot Repair.

1.4.1 Field Service Replacement.Instructions for performing a quick performance check and conducting top-level fault isolation of the monitor's field replaceable boxes (i.e., the WPU, DCU, PCU and AS201 Power Adapter), including disposable/consumable parts (see Section 10) are provided in this Field Service Manual. This manual also contains a brief introduction to the **3160 Series MRI Physiological Monitor**, as well as theory of operation and troubleshooting/repair procedures at the box level, calibration, verification and adjustment procedures, a spare parts list and other field maintenance instructions to support this first level of repair.

Figure 1-3 WSPO2 Telemetry Transmitter

This manual is divided into the following major sections:

Section	Description
1	INTRODUCTION - This section contains a general description of the monitor and its major assemblies, features and capabilities.
2	INSTALLATION AND CHECKOUT - This section includes monitor preinstallation/installation/mounting procedures as well as instructions for turning the monitor on and performing a quick hardware performance check of the monitor.
3	OPERATION - This section contains maintenance-significant descriptions of the monitor's controls and indicators and provides maintenance-related monitor operating procedures.
4	THEORY OF OPERATION - This section provides system level theory of operation for the monitor, including primary power distribution and radio transceiver information. An overall block diagram and primary power distribution diagram are also included for general reference purposes.
5	CALIBRATION AND VERIFICATION PROCEDURES - This section contains all of the field calibration and verification procedures for the monitor. These procedures should be run either after corrective maintenance is performed or during regularly scheduled preventive maintenance activities as specified in this manual.
6	ADJUSTMENT PROCEDURES - This section contains all of the field adjustment procedures for the monitor. These procedures should be run either after corrective maintenance is performed or during regularly scheduled preventive maintenance activities as specified in this manual.

Section	Description
7	MAINTENANCE - This section contains general purpose field maintenance instructions for servicing the monitor. These instructions include: procedures for conducting preventive/corrective maintenance on and cleaning the monitor; monitor assembly/disassembly procedures; maintenance access procedures for troubleshooting setup (see Section 9); battery tests and guidelines for using the Spare Parts List (see Section 10) and Maintenance Drawings (see Appendix J) to identify and order replacement parts.
8	RADIO PROGRAMMING INSTRUCTIONS - This section provides instructions for programming the wireless HE119 radio transceivers located in the WPU and DCU assemblies, as well as procedures for reprogramming the associated Network Numbers for both units.
9	TROUBLESHOOTING PROCEDURES - This section provides basic troubleshooting procedures for common problems (or faults) that may be observed while operating, or attempting to operate, the monitor in the field. These procedures are supported by a series of Functional Block Diagrams (see Appendix J) and, where applicable, also refer to separate instructions for clearing AB213 power board error codes (see Appendix G) to facilitate field service repair of the monitor.
10	SPARE PARTS LIST - This section contains a list of field replaceable parts for the monitor. All major assemblies and disposable/consumable parts are listed by order/part number for ease of reference.

A series of Appendixes provide additional information/instructions to support field servicing and repair of the monitor:

- Appendix A - LIST OF SYMBOLS
- Appendix B - REPAIR
- Appendix C - WARRANTY
- Appendix D - PRODUCT SPECIFICATIONS
- Appendix E - WPU KEYBOARD NAVIGATION FEATURE
- Appendix F - BAROMETRIC PRESSURE GRAPH
- Appendix G - AB213 POWER BOARD ERROR CODES
- Appendix H - COMPONENT LOCATION DIAGRAMS
- Appendix I - PREVENTIVE MAINTENANCE CHART
- Appendix J - MAINTENANCE DRAWINGS

A GLOSSARY, INDEX, and list of REFERENCES are also included in the back of this manual for ease of user reference.

1.4.2 Depot Repair. Defective monitors can also be shipped to Invivo for internal testing and repair (see Appendix B) once prior return authorization has been obtained from our in-house Technical Support engineers. Invivo's trained technicians can perform more detailed verification checks, equipment adjustments, troubleshooting, fault isolation and repair at the subassembly or circuit board level. When faulty monitors have been repaired and thoroughly checked for proper operation, Invivo will ship the repaired items back to the biomedical field technician for final verification and return to service in the clinical environment.

1.5 Contact Us. Invivo Corporation's Technical Support engineers are available 24 hours a day to assist clinical engineering personnel in troubleshooting and repairing Invivo Corporation's products. They are experts in our product line and are qualified to help you resolve any issues that may arise. Internationally, Invivo Research utilizes distributors who are well trained on our product line as well. The Technical Support Department also publishes product service bulletins as well as providing technical training to clinical engineering personnel.

Current domestic and international contact Voice/FAX telephone numbers for the Invivo Technical Support Department are available by accessing the following webpage: http://www.invivocorp.com/service/index.htm.

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SECTION 2
INSTALLATION AND CHECKOUT

2.0 INSTALLATION AND CHECKOUT.

2.1 Preinstallation. Refer to Appendix D for a description of facility environmental and power requirements, dimensions, weight and other product specifications for the **3160 Series MRI Physiological Monitor**. Ensure that all applicable environmental, power and space requirements are met before installing the monitor in the facility.

2.2 Monitor Mounting. Select a location where the monitor will not come in contact with liquids and where the heat will not raise the monitor's temperature above 44° C (110° F). Maintain adequate air flow around the unit to help keep it within the normal operating temperature range. There are air holes on the bottom and rear of the monitor that must not become clogged or closed off. Humidity and temperature must never combine to cause condensation to form in or on this monitor.

2.3 Preparing the 3160 Series MRI Physiological Monitoring System for Use. Perform the following steps to prepare the monitor for use:

a. Ensure that you have read the "PRECAUTIONS" and "USER RESPONSIBILITY" data in the front section of this manual. This information (see Pages xii and xviii, respectively) applies to any circumstance in which the biomedical field technician is performing maintenance tasks (corrective or preventive) on the monitor.

b. Ensure that there are no cracks in the monitor case or display.

c. Ensure that all patient connections are intact.

d. Ensure that all patient cables meet manufacturers recommended condition for patient use. Visually inspect for breaks, cracks and/or fraying.

e. Report any problems to Invivo, or an authorized Invivo Service Representative (see Section 1: Page 1-6, paragraph 1.5).

2.4 Connecting the Monitor to Power. Perform the following procedure to connect the **3160** monitor to Power (see Figure 2-1):

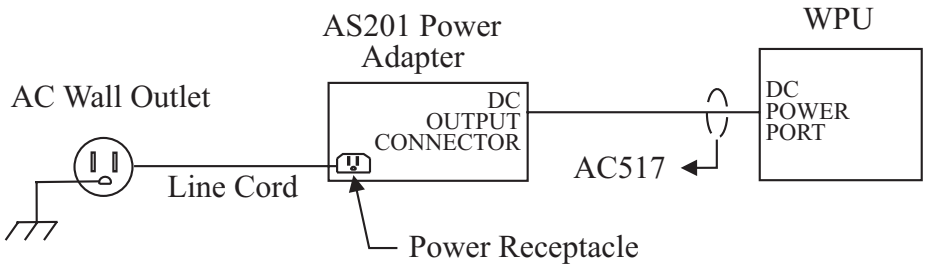

Figure 2-1. Monitor Setup

a. Ensure that the detachable DCU unit is securely seated into the retaining slot at the top of the MRI pole (see Section 1: Figure 1-1), and the Power Switches on the PCU (see Section 3: Figure 3-5) and DCU (see Section 5: Figure 5-1) are initially set to the OFF (⏻) position.

WARNING

For safety reasons, it is important that the **3160** monitor be powered from an outlet where the ground plug receptacle is connected to earth ground. Do not remove the grounding conductor from the power plug or use electrical power without proper grounding.

b. Plug the line cord into a hospital grade AC wall outlet.

c. Plug the other end of the line cord into the AC INPUT power receptacle on the **AS201 Power Adapter** (see Section 3: Figure 3-8).

d. Confirm that the green DC OUTPUT indicator on the **AS201** front panel (see Section 3: Figure 3-8) is illuminated.

e. Plug 3160 power cable AC517 into the **AS201** DC Output connector (see Section 3: Figure 3-8) and **3160** (WPU unit) DC power port (see Section 3: Figure 3-4).

f. Confirm that the tri-color Power Status Indicators on the PCU (see Section 3: Figure 3-5) and DCU (see Section 5: Figure 5-1) are both flashing green.

2.5 Turning the Monitor On. Perform the following procedure to apply power to the **3160** monitor:

a. Connect the monitor to power (see Page 2-1, paragraph 2.4).

b. Ensure the sealed 9064 backup batteries are installed in the WPU and DCU units (see Section 7: Page 7-15, paragraph 7.8.4).

NOTE

For first use, it is recommended to allow the batteries to charge a minimum of 8 hours before utilizing the monitor for battery use. For normal use the monitor should be plugged into an AC electrical outlet through the AS201 Power Adapter and not on battery power.

c. Set the Power Switch on the PCU (see Section 3: Figure 3-5) to the ON (⊙) position (the WPU powers up).

d. Set the Power Switch on the DCU (see Section 5: Figure 5-1) to the ON (⊙) position (the DCU powers up).

e. Confirm that the DCU display shows the Normal Screen (see Figure 2-2), and the tri-color Power Status Indicators on the PCU (see Section 3: Figure 3-5) and DCU (see Section 5: Figure 5-1) are both solid green (not yellow, red *or* flashing).

NOTE

The contents of the Normal Screen may vary depending on the options installed in the monitor.

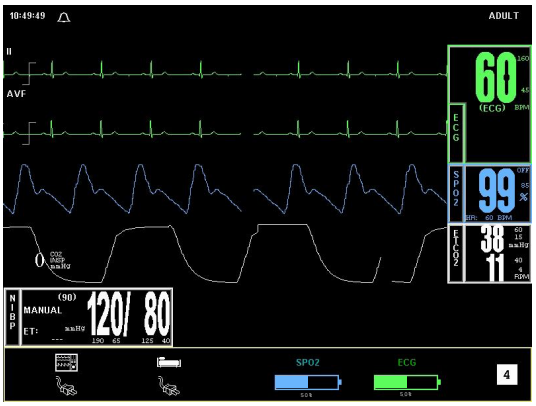

Figure 2-2. DCU - Sample Normal Screen

2.6 Operational Checkout Procedure. Before releasing the **3160** monitor for initial use in a clinical environment, connect the NIBP Hose/Cuff to the monitor and ensure a charged battery is inserted into the WSPO2 transmitter, then perform the following quick performance check(s) on the equipment:

NOTE

The following "quick check" procedure does not completely verify the operational readiness of the monitor. Reference Section 5 of this manual for more detailed, comprehensive Calibration and Verification Procedures.

NOTE

The maintenance technician may photocopy the quick checks on the following page and use them during initial monitor installation or after replacing a defective part to record the successful completion of each step.

3160 MONITOR QUICK PERFORMANCE CHECK(S)

a. Turn the monitor ON (see Page 2-2, paragraph 2.5) with the DCU and WPU units connected.

(1) ☐ Verify that the DCU display shows the Normal Screen.

(2) ☐ Verify that the tri-color Power Status Indicators on the PCU and DCU are both solid green (not yellow, red *or* flashing).

b. ☐ Press the **NIBP START/STOP** control key on the DCU and verify that the NIBP pump starts and inflates the cuff.

c. ☐ Press the **NIBP START/STOP** control key again and verify that the NIBP pump stops.

d. ☐ Test the SPO2 parameter alarm system as follows:

(1) Turn the Rotary Knob on the DCU until the SPO2 icon is highlighted, then press the **ALARMS SCREEN** control key.

(2) Turn the Rotary Knob until the **OFF** option is highlighted, then press the knob.

(3) Turn the Rotary Knob until a value of **99** is highlighted, then press the knob.

(4) Apply the SPO2 sensor to your finger and wait for the SPO2 reading to be displayed.

(5) Disconnect the SPO2 sensor from your finger.

(6) Verify that the monitor sounds an audio alarm and the SPO2 "Probe Off" message is displayed.

(7) Press the **ALARM SILENCE** control key.

(8) Reconnect the SPO2 sensor to your finger.

(9) Verify that the "Searching" message is displayed until the SPO2 reading is re-displayed on the monitor.

e. ☐ Press the **RECORD** control key on the DCU and verify the recorder starts.

f. ☐ Press the **RECORD** control key again and verify the recorder stops.

g. ☐ Ensure backup batteries are inserted in the DCU and WPU units.

h. ☐ Unplug AS201 power cable AC517 from the **3160** DC power port (DCU or WPU) and verify the monitor continues to operate normally on battery backup power.

i. ☐ Set the Power Switches on the PCU and DCU to the OFF (⏻) position (the monitor powers down).

j. ☐ Reconnect the AS201 power cable to the monitor and allow batteries to fully recharge before use.

SECTION 3
OPERATION

3.0 OPERATION.

3.1 Introduction. This section includes descriptions of the maintenance-significant controls and indicators for the DCU, WPU, PCU, AS201 Power Adapter, WECG and WSPO2 modules, and battery chargers. Operating procedures include maintenance specific instructions for both offline and online **3160 Series MRI Physiological Monitor** operation.

3.2 Controls and Indicators. The following paragraphs present maintenance-specific controls and indicatos for the **3160 Series MRI Physiological Monitor**. Each control and indicator section contains a figure of the specified equipment with Item number call outs for all applicable switches, fuses, knobs, indicator lights and ports/connections. Each figure is backed by a tabular listing, by assigned Item number, the control or indicator, and the function/purpose of each control or indicator.

3.2.1 DCU Front Panel. Refer to Section 5: Page 5-1, Figure 5-1 for a visual depiction (and Page 5-2, paragraph 5.4.2 through Page 5-3, paragraph 5.4.4 for associated functional descriptions) of the DCU front panel power switch/indicator, display screen and control panel.

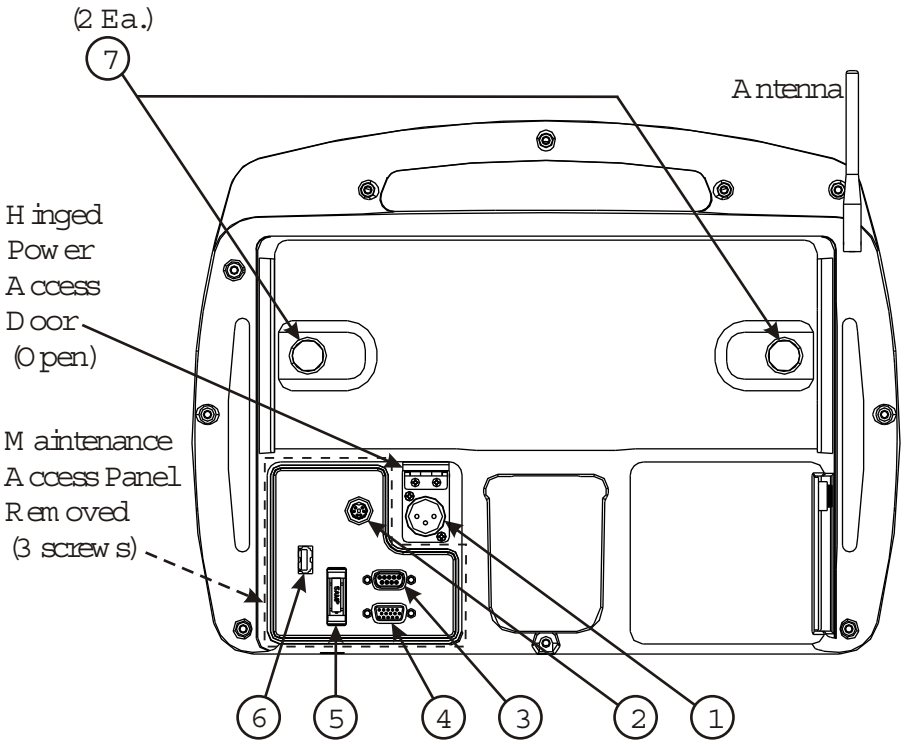

Figure 3-1. DCU Rear Panel

3.2.2 DCU Rear Panel. (See Figure 3-1) The following is a description of the DCU rear panel connections and inputs.

NOTE

The following DCU Power Port can only be used to power the detachable DCU unit if it has been removed from the MRI pole. Otherwise, the DCU is powered either by its internal batteries or via the AS201 Power Adapter's hard-wired connection to the WPU.

a. **DC Power Port (Item 1).** The DC power port (located behind the hinged power access door) provides for the connection of +18 Vdc from the DC output connector on the AS201 Power Adapter via power cable AC517.

b. **Keyboard Connection (Item 2).** The keyboard connection provides for the attachment of a standard IBM-compatible keyboard for manually programming the DCU's HE119 radio transceiver (see Section 8).

c. **RS-232 Serial Connection (Item 3).** This connection is intended for factory use only.

d. **VGA Monitor Connection (Item 4).** The VGA monitor connection provides for the optional attachment of a standard IBM-compatible VGA/SVGA monitor for manually programming the DCU's HE119 radio transceiver (see Section 8).

e. **DC Fuse (Item 5).** The FU39 5A, 32V power fuse provides overcurrent protection for the +18 Vdc input power from the AS201 Power Adapter.

f. **USB Programming Port (Item 6).** The USB programming port provides for the attachment of an Invivo flash drive unit for performing automatic (SmartBoot) reprogramming of the DCU's operating software (see Section 7: Page 7-3, paragraph 7.5).

g. **Battery Release Buttons (Item 7).** The battery release buttons are separately pressed to release the associated 9064 batteries from their respective compartments.

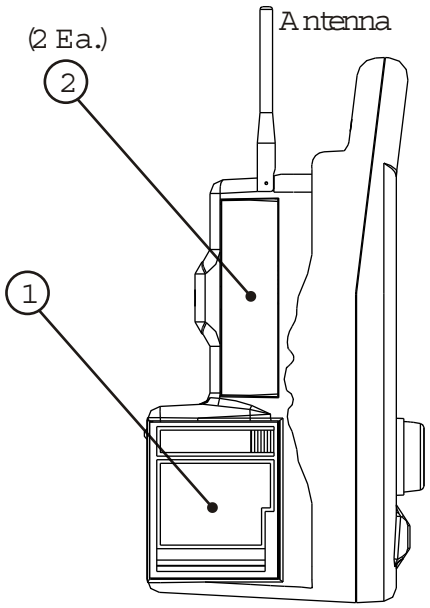

Figure 3-2. DCU Side Panel

3.2.3 DCU Side Panel. (See Figure 3-2) The DCU side panel contains the recorder assembly and 9064 batteries (one in each side panel).

a. **Recorder Unit (Item 1).** The HT18 recorder assembly provides a printout of patient parameter data either automatically or upon operator demand.

b. **Battery Compartments (Item 2).** The battery compartments located on both the left and right DCU side panels each hold one rechargeable 9064 battery. The backup batteries permit battery operation of the DCU for brief periods of time (up to 8 hours). The batteries are intended for use only when the monitor is being moved, or when it cannot be readily connected to the MRI pole or directly to the AS201 power adapter for normal DC input power.

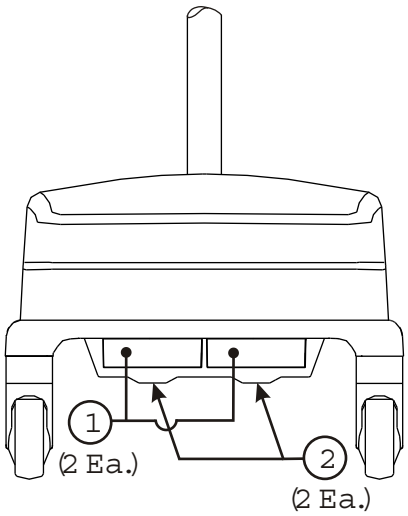

Figure 3-3. WPU Front Panel

3.2.4 WPU Front Panel. (See Figure 3-3) The following is a description of the WPU front panel connections and inputs.

a. **Battery Compartments (Item 1).** The battery compartments each hold one rechargeable 9064 battery. The backup batteries permit battery operation of the WPU for brief periods of time (at least 8 hours). The batteries are intended for use only when the monitor is being moved, or when it cannot be readily connected to the AS201 power adapter for normal DC input power.

b. **Battery Release Buttons (Item 2).** The battery release buttons are separately pressed to release the associated 9064 batteries from their respective compartments.

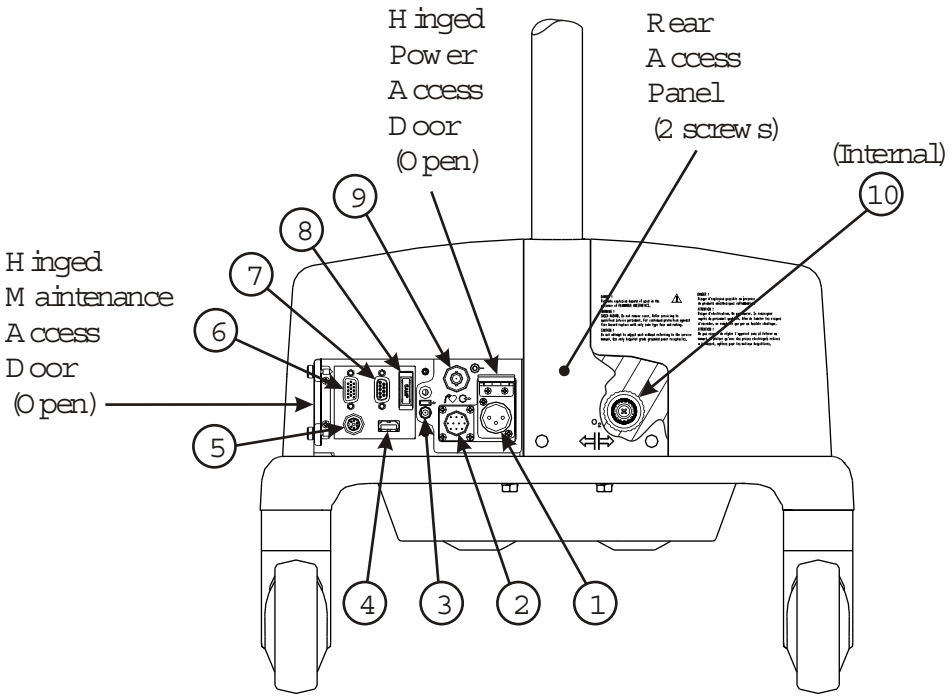

Figure 3-4. WPU Rear Panel

3.2.5 WPU Rear Panel. (See Figure 3-4) The following is a description of the WPU rear panel connections and inputs.

a. **DC Power Port (Item 1).** The DC power port (located behind the hinged power access door) provides for the connection of +18 Vdc from the DC output connector on the AS201 Power Adapter via power cable AC517.

b. **Gating Port (Item 2).** The Gating port provides for the connection of a cardiac/pulse synchronization interface to an MRI scanner equipped with gating capability.

c. **Waste Gas Exhaust Port (Item 3).** The waste gas exhaust port is used for release of waste gas. It is constructed to allow for connection into any existing Gas Scavenge system.

d. **USB Programming Port (Item 4).** The USB programming port provides for the attachment of an Invivo flash drive unit for performing automatic (SmartBoot) reprogramming of the WPU's operating software (see Section 7: Page 7-3, paragraph 7.5).

e. **Keyboard Connection (Item 5).** The keyboard connection provides for the attachment of a standard IBM-compatible keyboard for offline operation in the Keyboard Navigation mode (see Appendix E), or for manually programming the WPU's HE119 radio transceiver (see Section 8).

f. **VGA Monitor Connection (Item 6).** The VGA monitor connection provides for the attachment of a standard IBM-compatible VGS/SVGA monitor for offline operation in the Keyboard Navigation mode (see Appendix E), or for manually programming the WPU's HE119 radio transceiver (see Section 8).

g. **RS-232 Serial Connection (Item 7).** This connection is intended for factory use only.

h. **DC Fuse (Item 8).** The FU39 5A, 32V power fuse provides overcurrent protection for the +18 Vdc input power from the AS201 Power Adapter.

i. **RF Hard-Wired Link (Item 9).** The RF hard-wired link is used to connect the WPU unit to a remote DCU unit through a penetration panel when the monitor is equipped with the hard-wired radio communications option.

j. **Oxygen Sensor (Item 10).** The disposable oxygen sensor (located behind the rear access panel) is used when the monitor is equipped with the anesthetic agent option to measure concentration of oxygen in the room air and to/from the patient.

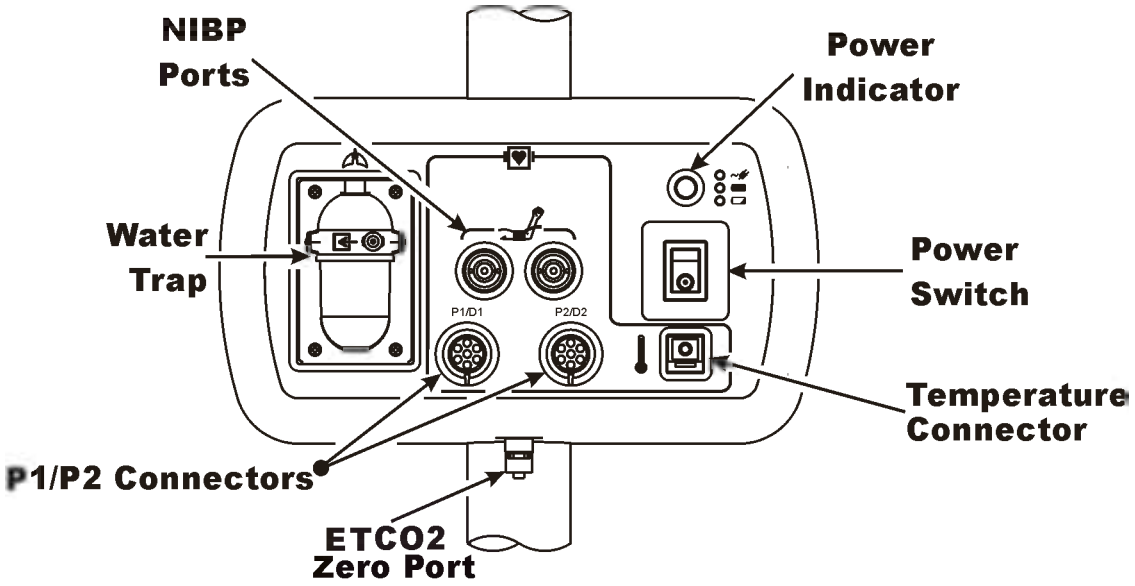

Figure 3-5. PCU Front Panel

3.2.6 PCU Front Panel. (See Figure 3-5) The PCU front panel provides for the connection of patient cabling for the **3160 Series MRI Physiological Monitor**. The panel contains connections for the attachment of NIBP hoses and Gas (EtCO2 or Agents) patient sample tubing. Connections for IBP (P1/D1 and P2/D2) and Temperature options are also provided on this panel.

a. **EtCO2 Zero Connection.** The EtCO2 Zero port is used for zeroing of the optional EtCO2/Anesthetic Agent Gas module.

b. **P1/D1 and P2/D2 IBP Connections.** The IBP ports provide for the connection of two IBP probes for taking patient invasive blood pressure measurements.

c. **Gas Input Port and Water Trap.** The water trap (pictured above) is used when a Gas Option is installed. The Gas Input Port allows for measurement of the optional EtCO2/ Anesthetic Agent patient parameter.

d. **NIBP Ports.** The NIBP ports provide for the connection of the NIBP patient cuff.

e. **Power Indicator - Tri-color LED.** The Status LED monitors the WPU's current power source and wireless radio communication status between the WPU and DCU.

- **Slow Flashing Green** - (blinks every 2 1/2 seconds) Indicates the presence of +18 Vdc output power from the AS201 Power Adapter.
- **Solid Green** - Indicates the monitor is operating on +18 Vdc output power from the AS201 Power Adapter.
- **Solid Yellow** - Indicates the monitor is operating on +14 Vdc output power from the two (2) 9064 backup batteries.
- **Solid Red** - Indicates the WPU is operating on battery power, the batteries are depleted and power failure is imminent.

- **Rapid Flashing Yellow or Red** - (blinks every 1/2 second) Indicates the absence of a wireless communication link between the WPU and DCU units when their associated Power Switch(es) (see Item 8 below) are set to the ON position. The WPU and DCU must be set to the same Network Number to obtain this link (see Section 8: Page 8-4, paragraph 8.5 and Page 8-4, paragraph 8.6).
- **Extinguished** - Indicates no power is available to the WPU.

f. **Power Switch.** The Power Switch allows the operator to enable or disable power for the WPU unit. The batteries are charged when the Power Switch is in either the ON (⊙) or OFF (ȯ) position. (Batteries will charge more rapidly when this switch is set to OFF.)

g. **Temperature Connector.** The Temperature port provides for the connection of a FISO Temperature probe for taking patient temperature measurements.

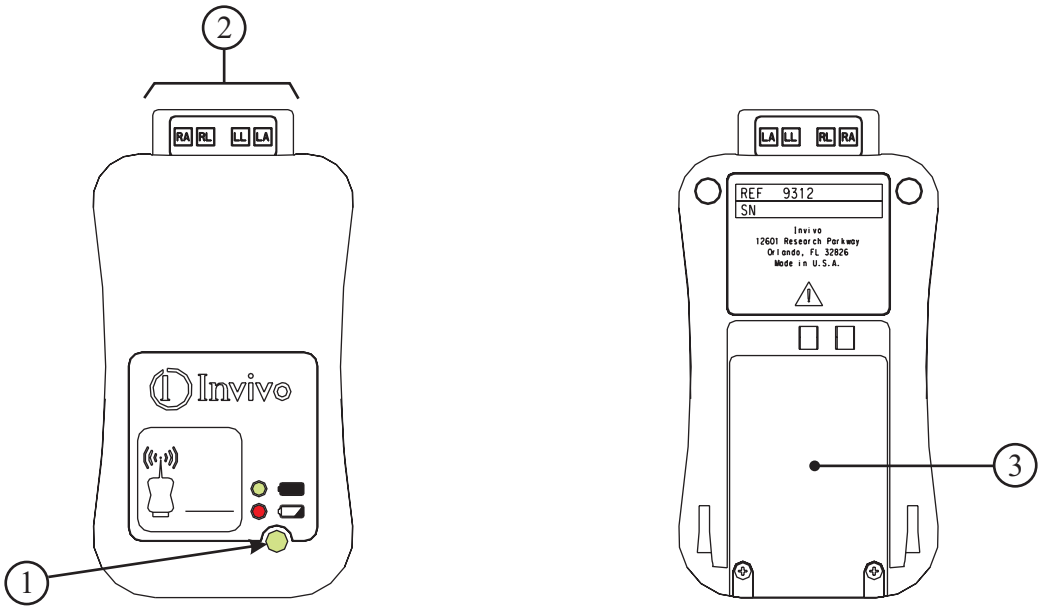

Figure 3-6. WECG Transmitter Module

3.2.7 WECG Transmitter Module. (See Figure 3-6) The WECG transmitter module provides connections for ECG probe leads, a battery compartment to house a 9065 Patient Module 4.1V LI Battery and a Power Indicator.

a. **Power Indicator - Bi-color LED (Item 1).** The Power LED monitors the status of the Patient Module 4.1V LI Battery.

- **Flashing Green** - Indicates the presence of +4.1 Vdc output power from the LI Battery.
- **Flashing Red** - Indicates a battery low condition for the LI Battery.

b. **ECG Connections (Items 2).** The ECG ports provide for the connection of an ECG probe for taking patient ECG measurements.

c. **Battery Compartment (Item 3).** The battery compartment located on the back of the WECG module holds one rechargeable Patient Module 4.1V LI Battery.

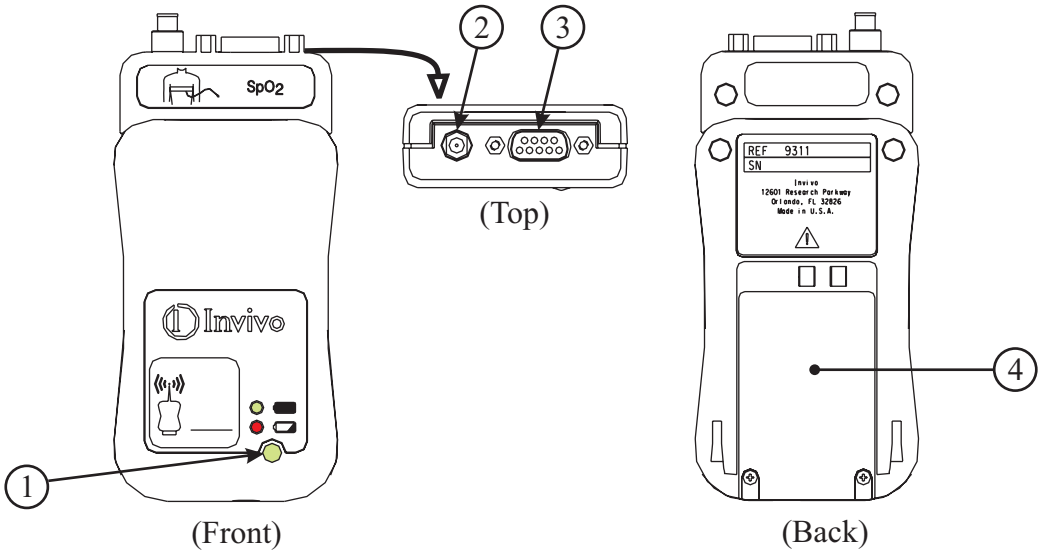

Figure 3-7. WSPO2 Transmitter Module

3.2.8 WSPO2 Transmitter Module. (See Figure 3-7) The WSPO2 transmitter module provides connections for the SPO2 probe, an optional Respiration pillow sensor, a battery compartment to house a 9065 Patient Module 4.1V LI Battery and a Power Indicator.

a. **Power Indicator - Bi-color LED (Item 1).** The Power LED monitors the status of the Patient Module 4.1V LI Battery.

- **Flashing Green** - Indicates the presence of +4.1 Vdc output power from the LI Battery.
- **Flashing Red** - Indicates a battery low condition for the LI Battery.

b. **RESP Port (Item 2).** The RESP port provides for the connection of a Belllows pillow sensor for taking patient respiration measurements.

c. **SPO2 Connection (Item 3).** The SPO2 port provides for the connection of an SPO2 probe for taking patient SPO2 measurements.

d. **Battery Compartment (Item 4).** The battery compartment located on the back of the WSPO2 module holds one rechargeable Patient Module 4.1V LI Battery.

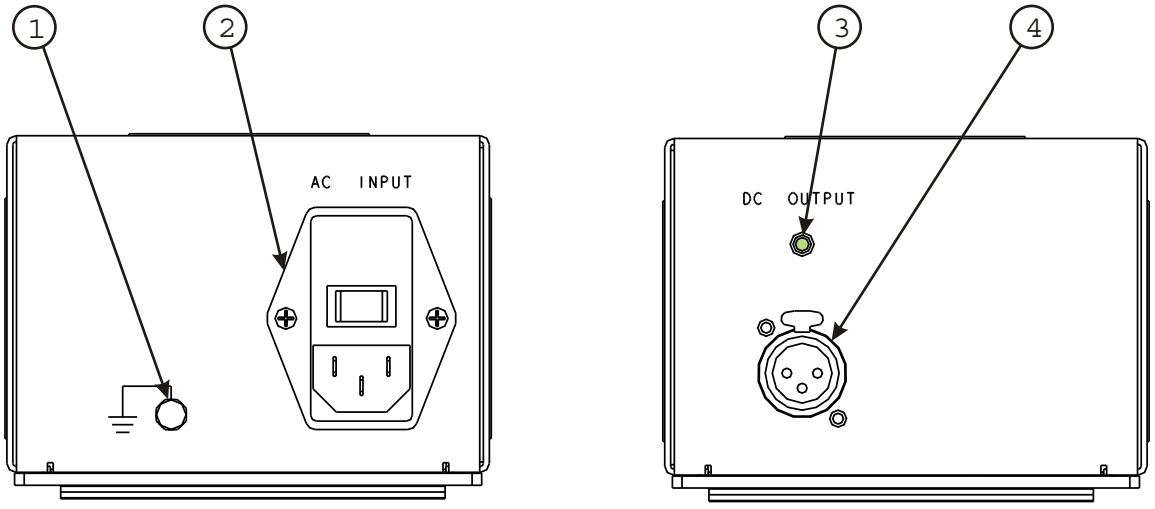

Figure 3-8. AS201 Power Adapter

CAUTION

The AS201 AC Power Adapter is used inside the Magnet Room. It must be kept outside the 1000 Gauss (0.1 T) Field Line of the MRI System (this means at least 10 feet or 3 meters away from the MRI Magnet for most 1.5 T magnets).

3.2.9 AS201 Power Adapter. (See Figure 3-8) The following is a description of the AS201 AC Power Adapter's connections, controls and indicators:

a. **Ground Terminal (Item 1).** The external Ground Terminal provides a readily accessible circuit ground connection for the AS201.

b. **AC INPUT Line Filter (Item 2).** The HE98 line filter contains the FU12 1.5A, 250V fuses to protect the monitor from surges in AC power and an AC Input power receptacle for connecting the unit to facility AC power.

c. **DC OUTPUT Indicator (Item 3).** The Power LED illuminates green when +18 Vdc is available at the DC output connector.

d. **DC Output Connector (Item 4).** The +18V DC output connection is where the **AS201** is connected to the **3160 Monitor** via the AC517 power cable.

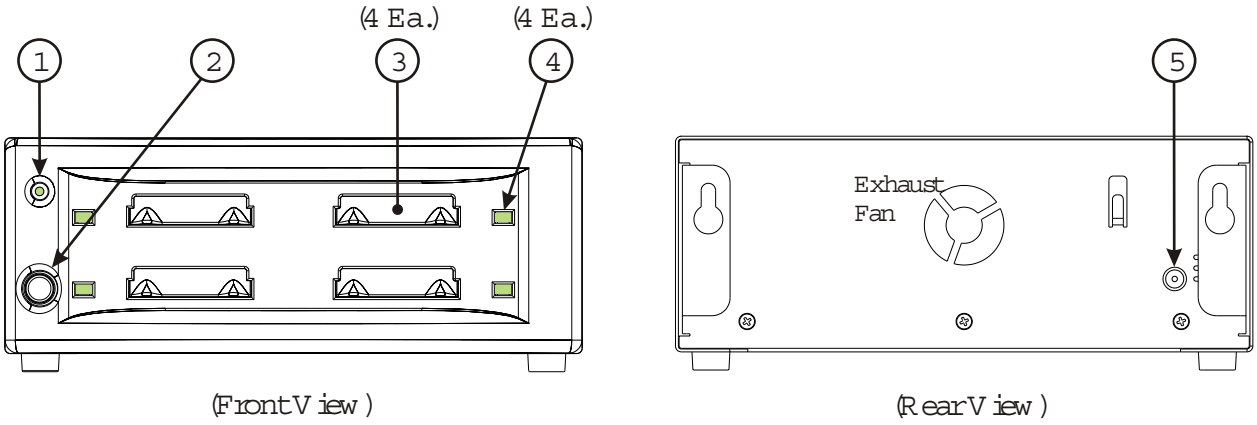

Figure 3-9. WECG/WSPO2 Patient Module Battery Charger

3.2.10 WECG/WSPO2 Patient Module Battery Charger. (See Figure 3-9) The Patient Module Battery Charger is used offline to charge the 9065 lithium batteries located in the wireless WECG and WSPO2 patient modules. The following is a description of the 9023 Patient Module Battery Charger indicators and connections.

a. **Charger Power - Green LED (Item 1).** This LED indicates when +24 Vdc input power from the AC adapter is present.

b. **Battery Discharge Switch (Item 2).** When pushed, this momentary switch places the battery inserted in the lower, left-hand battery slot in a reconditioning discharge cycle. (The associated Battery Charge LED will illuminate solid blue.)

c. **9065 Battery Slot - 4 Ea. (Item 3).** Each battery slot provides for insertion of a separate 9065 lithium battery for recharging purposes.

d. **Battery Charge RGB LEDs - 4 Ea. (Item 4).** These LEDs indicate the current status of the batter(ies) inserted in the 9065 battery bay(s):

- **Solid Green** - Indicates the associated battery is fully recharged and ready for reuse.
- **Flashing Green** - Indicates the associated battery currently has a medium charge and is successfully recharging.
- **Flashing Yellow** - Indicates the associated battery currently has a low charge and is successfully recharging.
- **Solid Red** - Indicates a faulty or dead battery (discard the associated battery).
- **Solid Blue** - Indicates the battery in the lower, left-hand battery slot is currently in a reconditioning discharge cycle.
- **Flashing Blue** - Indicates the associated battery requires reconditioning. (The battery must be inserted into the lower, left-hand battery slot to be reconditioned.)
- **Extinguished** - Indicates no battery is inserted in the associated battery slot.

e. **AC Adapter Connection - (Item 5).** This jack provides for the connection of an AC adapter to supply the charger with +24 Vdc input power.

3.2.11 WPU/DCU Battery Charger. The WPU/DCU Battery Charger is a future option to be used offline to charge the 9064 lithium batteries located in the WPU and DCU units.

3.3 Operating Procedures. Operating procedures for the **3160 Series MRI Physiological Monitor** are presented in the following paragraphs. These procedures include maintenance significant instructions for both offline and online operation. Offline operating instructions consist of maintenance-related tasks that are not performed on the monitor itself (e.g., battery charging procedures) or can only be performed when the monitor is disassembled/setup on the repair bench by qualified technicians (e.g., Maintenance Access procedures); online instructions include all other maintenance-related procedures that can be performed readily by a medical practitioner (without the use of additional support/test equipment) on the fully assembled monitor in the clinical environment as well as in the bio-medical lab.

3.3.1 Offline Operation. Offline operating procedures for the **3160 Series MRI Physiological Monitor** are presented in the following paragraphs. These procedures are: System Tests, WPU Service (Bio-Med) Features, Software Installation procedures, Maintenance Access procedures, WPU/DCU and patient module battery charging procedures, and changing the WPU HE119 network number.

a. **System Tests.** Refer to Section 7: Page 7-3, paragraph 7.4.1 for 3160 monitor System Test and Verification procedures.

NOTE

The WPU menu system can only be accessed when the monitor is offline by using the WPU Keyboard Navigation (Nav) feature. Please refer to Appendix E in this manual for guidelines to setup and operate the monitor in this mode.

b. **WPU Service (Bio-Med) Feature.** Selecting the **Service (Bio-Med)** option from the WPU **SETUPS** menu will bring up the WPU **SERVICE (BIO-MED)** Menu (Figure 3-10). The WPU SERVICE (BIO-MED) Menu provides the operator with the ability to identify the Software Revision level, place the system into a Simulation Mode (used for training/demonstration purposes only), perform NIBP tests, calibrate the anesthetic agent option and EtCO2 (if available), calibrate the monitor and adjust the configuration of the system.

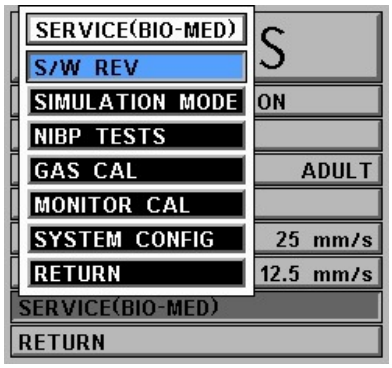

Figure 3-10. WPU SERVICE (BIO-MED) Menu

The following is a description of the options available in the WPU **SERVICE (BIO-MED)** Menu:

(1) **S/W REV.** Selecting this menu item brings up another window which contains detailed information about the operating software of the WPU. This Software Revision Screen (Figure 3-11) contains the revision level and date of build along with other technical information concerning the WPU software. To exit this window, select the OK button on the window or the **NORMAL SCREEN** control key on the monitor front panel.

NOTE

The contents of the Software Revision Screen will vary depending on the options and latest software update/upgrade installed in the monitor.

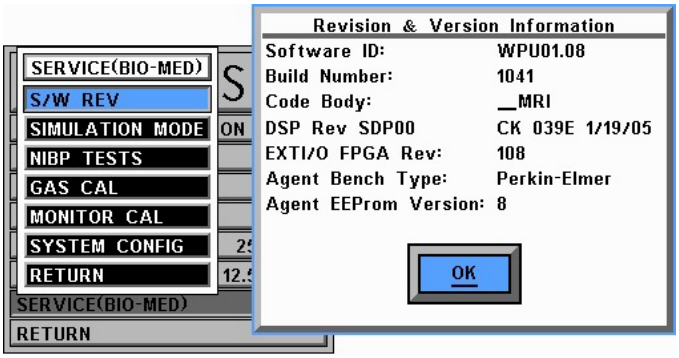

Figure 3-11. Sample WPU Software Revision Screen

WARNING

The Simulation Mode will display real looking waveforms which are computer generated. The monitor will not monitor patients while in the Simulation Mode. **Do not activate the Simulation Mode with the monitor attached to a patient.** To exit the Simulation Mode, the monitor must be powered Off.

(2) **SIMULATION MODE.** This menu option allows the operator to turn the Simulation Mode ON. Selecting this menu option will first bring up a YES/NO selection screen (Figure 3-12) to ensure that this menu was not selected by accident. When YES is selected, the monitor enters the Simulation Mode of operation. While in the Simulation Mode the displayed patient information is computer generated and not actual patient determinations. As a safety feature, while in the Simulation Mode the message "**SIMULATION**" is displayed in the center of the screen (see Figure 3-13) and, when printing any strip or chart, "**SIMULATION**" will also appear on the printout (see Figure 3-14). To exit the Simulation Mode, the monitor must be powered Off.

Figure 3-12. Simulation Mode YES/No Screen

NOTE

The contents of the SIMULATION Screen may vary depending on the options installed in the monitor.

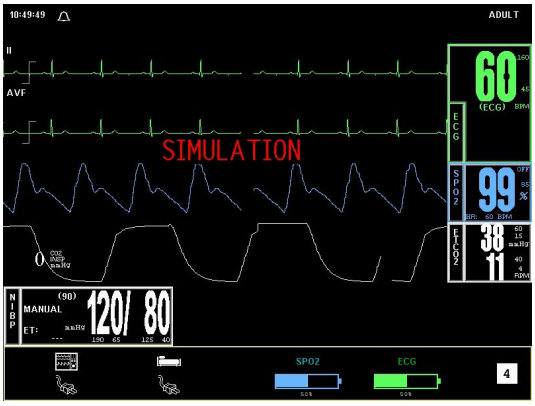

Figure 3-13. Sample SIMULATION Screen

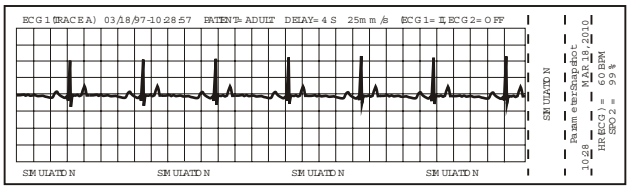

Figure 3-14. Sample SIMULATION Strip Chart Recording

(3) **NIBP TESTS.** Selecting this menu option will bring up the WPU **NIBP TESTS** Menu (Figure 3-15).

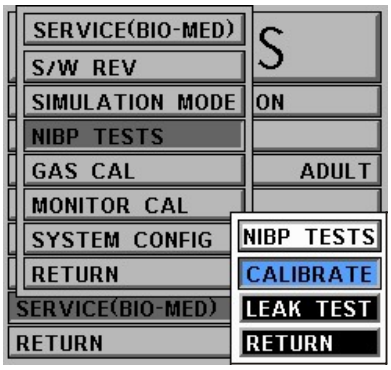

Figure 3-15. WPU NIBP TESTS Menu

The following options are provided in this menu:

(a) **CALIBRATE.** Selecting this menu option will display Offset Pressure (OFFSET PRESS) and Actual Pressure (PRESS READING) values in the WPU **NIBP CAL** Screen (Figure 3-16). These are used to verify and calibrate the internal NIBP primary and secondary transducers. To display these readings, highlight the CALIBRATE menu option and press the Rotary Knob; to exit this screen, press the Rotary Knob a second time.

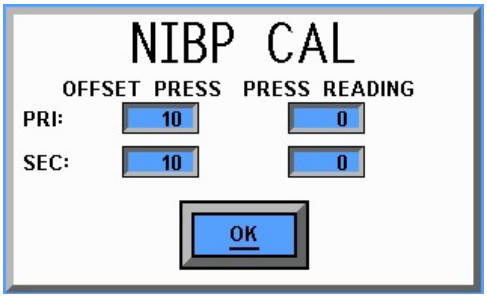

Figure 3-16. WPU NIBP CAL Screen

WARNING

Never initiate a Leak Test with an NIBP cuff attached to a patient. Continuous cuff pressure could lead to patient injury.

(b) **LEAK TEST.** Selecting this menu option will display the **NIBP LEAK TEST** Screen (Figure 3-17) with the Peak (beginning) Pressure and Final (current) Pressure displayed, along with the number of Passes and Failures of the test, to determine the leak rate of the NIBP system. To begin this test, highlight the LEAK TEST menu option and press the Rotary Knob; to stop a test in progress, press the Rotary Knob a second time.

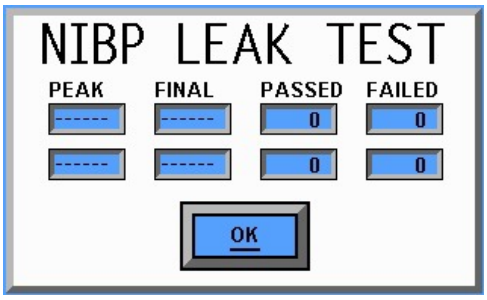

Figure 3-17. NIBP Leak Test Screen

(c) **RETURN.** Selecting this menu option returns the monitor to the Normal Screen.

(4) **GAS CAL (Gas Option Only).** Selecting this menu option will bring up the WPU **GAS CAL** Menu (Figure 3-18).

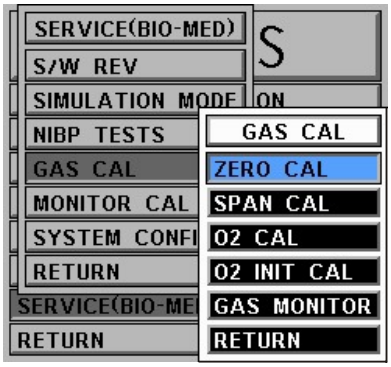

Figure 3-18. WPU GAS CAL Menu

The following menu options are provided in this menu:

(a) **ZERO CAL.** Selecting this menu option will cause the monitor to perform a Zero Cal of the EtCO2 or Agent System.

(b) **SPAN CAL (AB192B Agent Bench).** When the Agents option is installed, selecting this menu option will bring up a Password Entry Box (Figure 3-19) requiring a five (5) digit service code to access the WPU **SPAN CAL** Menu (Figure 3-20). This menu contains Gas Sensor Calibration settings which are used for Agent Bench field adjustment purposes.

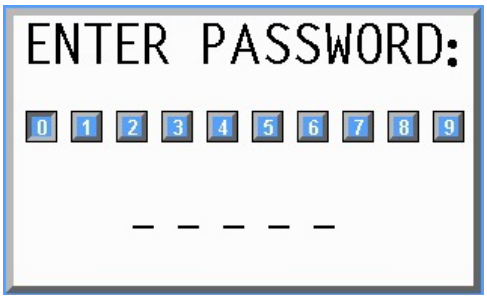

Figure 3-19. Password Entry Box

Figure 3-20. WPU SPAN CAL Menu

(c) **SPAN CAL (AB251A EtCO2 Bench).** When the EtCO2 option is installed, selecting this menu option will bring up a Password Entry Box (Figure 3-19) requiring a five (5) digit service code to access the WPU EtCO2 **SPAN CAL** Menu (Figure 3-21). This menu contains Gas Sensor Calibration settings which are used for EtCO2 Bench field adjustment purposes.

Figure 3-21. WPU EtCO2 SPAN CAL Menu

(d) **O2 CAL (Agents Option Only).** Selecting this menu option will cause the monitor to perform a one (1) minute calibration of the O2 Sensor. (During calibration, the PCU's patient GAS Input Port must not be connected to an oxygen source.)

NOTE

When the EtCO2 parameter is turned on the O2 sensor is automatically calibrated during initial warmup of the Agent/EtCO2 module. During this time, the PCU's patient GAS Input Port (see Page 3-5, paragraph 3.2.6, item "c") must not be connected to an oxygen source as the monitor requires 20.9% oxygen (room air) for proper O2 initial calibration.

(e) **O2 INIT CAL (Agents Option Only).** Selecting this menu option will cause the monitor to perform a two (2) minute calibration of the O2 Sensor. This calibration should be performed after every replacement of the O2 Sensor.

(f) **GAS MONITOR (Gas Option Only).** Selecting this menu option brings up the WPU Gas Monitor Screen (Figure 3-22). This box contains Gas Sensor Calibration characteristics which are used for EtCO2 or Agent Bench field calibration/verification purposes.

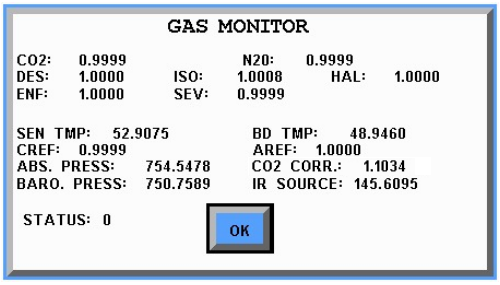

Figure 3-22. WPU Gas Monitor Screen

(g) **RETURN.** Selecting this menu option returns the monitor to the **SERVICE (BIO-MED)** Menu.

(5) **MONITOR CAL.** Selecting this menu option will first bring up a YES/NO selection screen (Figure 3-23) to ensure that this menu was not selected by accident. When YES is selected a second screen with Calibration Information on various operational aspects of the monitor appears (Figure 3-24). If this display should be selected, exit by turning the monitor off. It is important to note that if the Escape option is selected, the monitor will return control of the monitor to the operator but the Calibration Screen will remain on the display; to remove the Calibration Screen turn the monitor off.

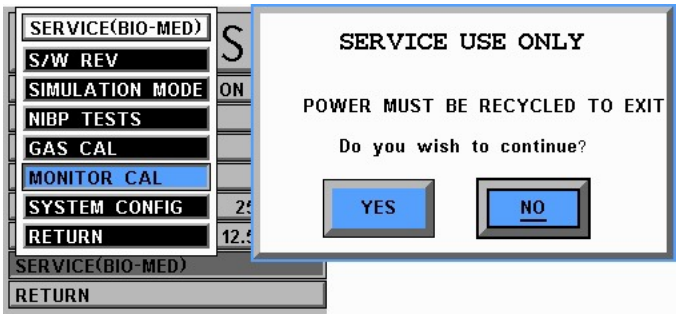

Figure 3-23. WPU Monitor Calibration YES/NO Screen

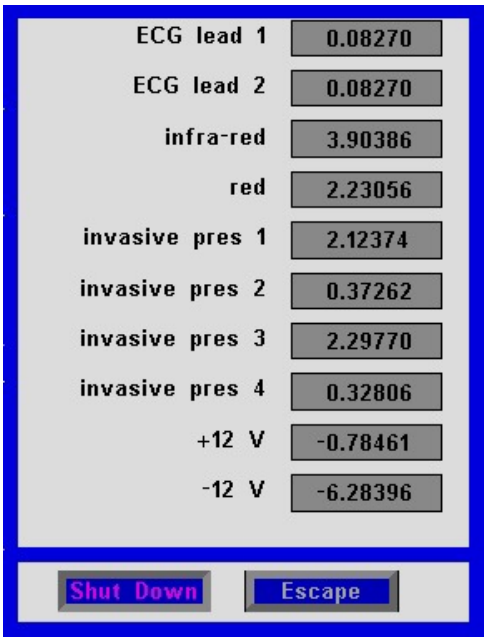

Figure 3-24. WPU Monitor Calibration Information Screen

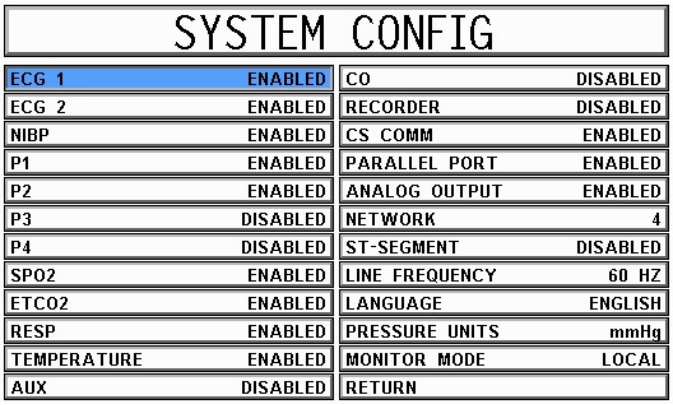

Figure 3-25. SYSTEM CONFIG Menu

(6) **SYSTEM CONFIG**. The **SYSTEM CONFIG** Menu (Figure 3-25) is brought up by selecting the **SYSTEM CONFIG** Menu option. Most of the options in this menu are sensitive and are, as a result, protected by a five (5) digit password that must be entered in the Password Entry Box (see Figure 3-19) before the option may be adjusted. The Language and Pressure Unit options are the only options in this menu which do not require that the service code be entered.

The following options are available in this menu:

(a) **ECG 1:** Selecting this menu option will enable/disable the ECG 1 module.

(b) **ECG 2:** Selecting this menu option will enable/disable the ECG 2 module.

(c) **NIBP:** Selecting this menu option will enable/disable the NIBP module.

(d) **P1:** Selecting this menu option will enable/disable the Pressure 1 module (if installed).

(e) **P2:** Selecting this menu option will enable/disable the Pressure 2 module (if installed).

(f) **P3:** This option is not available on the 3160 MRI Physiological Monitoring System.

(g) **P4:** This option is not available on the 3160 MRI Physiological Monitoring System.

(h) **SPO2:** Selecting this menu option will enable/disable the SPO2 module.

(i) **EtCO2:** Selecting this menu option will enable/disable the EtCO2 module (if installed).

(j) **RESP:** Selecting this menu option will enable/disable the RESP module (if installed).

(k) **TEMPERATURE:** Selecting this menu option will enable/disable the Temperature module (if installed).

(l) **AUX:** This option is not available on the 3160 MRI Physiological Monitoring System.

(m) **CO**: This option is for future service enhancement.

(n) **RECORDER:** Selecting this menu option will enable/disable the RECORDER module.

(o) **CS COMM:** Selecting this menu option will enable/disable CS COMM.

(p) **PARALLEL PORT:** Selecting this menu option will enable/disable the Parallel/Printer Port.

(q) **ANALOG OUTPUT:** Selecting this menu option will enable/disable the Analog Output Port.

(r) **NETWORK:** Selecting this menu option provides a method of connecting to a specific radio network.

(s) **ST-SEGMENT:** This option is not available on the 3160 MRI Physiological Monitoring System.

(t) **LINE FREQUENCY:** Selecting this menu option switches the ECG Notch Filter between 50 Hz and 60 Hz. This filter does not apply to ECG Diagnostic Filter Mode.

(u) **LANGUAGE:** (No password entry required) Selecting this menu option allows the Language of the monitor to be switched between the available languages (English, German, Spanish, Portuguese, Italian, Dutch, Swedish and French). To enable the language change, the operator must exit the **SYSTEM CONFIG** menu by selecting Return or pressing the **NORMAL SCREEN** control key, and then turn the monitor Off then On.

(v) **PRESSURE UNITS:** (No password entry required) Selecting this menu option allows the Blood Pressure and EtCO2 Measurement units to be switched between mmHg and kPa.

(w) **MONITOR MODE:** This menu item is set automatically depending on which unit is be looked at. (For the DCU, this option is set to REMOTE MODE. For the WPU, this option is set to LOCAL MODE.)

(x) **RETURN:** Selecting this menu option returns the monitor to the **Service (Bio-Med)** Menu.

(7) **RETURN.** Selecting this menu option returns the monitor to the **SETUPS** Menu.

c. **Software Installation Procedures.** Refer to Section 7: Page 7-3, paragraph 7.5 for 3160 monitor Software Installation procedures.

d. **Maintenance Access Procedures.** Refer to Section 7: Page 7-17, paragraph 7.9 for 3160 monitor Maintenance Access procedures.

e. **WPU/DCU Battery Charging Procedures.** The WPU/DCU battery charger is used in the console room when no AC wall outlets are available in the magnet room for the attachment of an AS201 Power Adapter to facilitate normal internal battery charging cycles.

Charge/recharge the WPU/DCU 14.4V lithium ion batteries as follows: Charge four spare batteries (Invivo P/N 9064) in the WPU/DCU battery charger. After 8 hours, replace the batteries in the WPU and/or DCU unit with the fully charged spare batteries and begin recharging the original batteries. Repeat as required according to frequency of use.

f. **Patient Module Battery Charging Procedures.** Charge/recharge the Patient Module 4.1V LI batteries as follows: Charge two spare batteries (Invivo P/N 9065) in the Patient Module battery charger (Invivo P/N 9023). After 8 hours, replace the batteries in the WECG and/or WSPO2 Module with the fully charged spare batteries and begin recharging the original batteries. Repeat as required according to frequency of use.

g. **Changing the WPU HE119 Network Number.** Refer to Section 8: Page 8-4, paragraph 8.6 for procedures to change the WPU HE119 transceiver Network Number.

NOTE

In addition to the following online operating procedures, reference should also be made to the **3160 Series MRI Physiological Monitor Operations Manual** (Invivo Part Number 9569) for general purpose operating instructions pertaining to this monitor in the clinical environment.

3.3.2 Online Operation. Online operating procedures for the **3160 Series MRI Physiological Monitor** are presented in the following paragraphs. These procedures are: monitor connection, turn-on, turn-off, operational quick checks, DCU Service (Bio-Med) Features and changing the DCU HE119 network number.

a. **Monitor Connection**. Refer to Section 2: Page 2-1, paragraph 2.4 for 3160 monitor connection procedures.

b. **Monitor Turn-On Procedures**. Refer to Section 2: Page 2-2, paragraph 2.5 for 3160 monitor turn-on procedures.

WARNING

Electrical shock hazard: Prior to removing any assemblies from the **3160** monitor, ensure that power to the monitor has been turned OFF as described above, the AS201 Power Adapter is unplugged and the batteries have been removed. Failure to comply can result in serious injury or death to personnel, and/or damage to the monitor's internal circuits.

c. **Monitor Turn-Off Procedures.** Perform the following procedure to remove power from the 3160 monitor:

(1) Set the Power Switch on the DCU to the OFF (⏻) position.

(2) Set the Power Switch on the PCU to the OFF (⏻) position.

d. **Operational Quick Checks.** Refer to Section 2: Page 2-3, paragraph 2.6 for 3160 monitor Operational Checkout procedures.

e. **DCU Service (Bio-Med) Feature.** Selecting the **Service (Bio-Med)** option from the DCU **SETUPS** menu will bring up the DCU **SERVICE (BIO-MED)** Menu (Figure 3-26). The DCU SERVICE (BIO-MED) Menu provides the operator with the ability to identify the Software Revision level, place the system into a Simulation Mode (used for training purposes only), perform certain Gas Calibration and NIBP Tests, and adjust the configuration of the system.

Figure 3-26. DCU SERVICE (BIO-MED) Menu

The following is a description of the options available in the **SERVICE (BIO-MED)** Menu:

(1) **S/W REV.** Selecting this menu item brings up another window which contains detailed information about the operating software of the DCU. This Software Revision Screen (Figure 3-27) contains the revision level and date of build along with other technical information concerning the DCU software. To exit this window, the operator either selects the OK button on the window or the **NORMAL SCREEN** control key on the monitor front panel.

NOTE

The contents of the Software Revision Screen will vary depending on the options and latest software update/upgrade installed in the monitor.

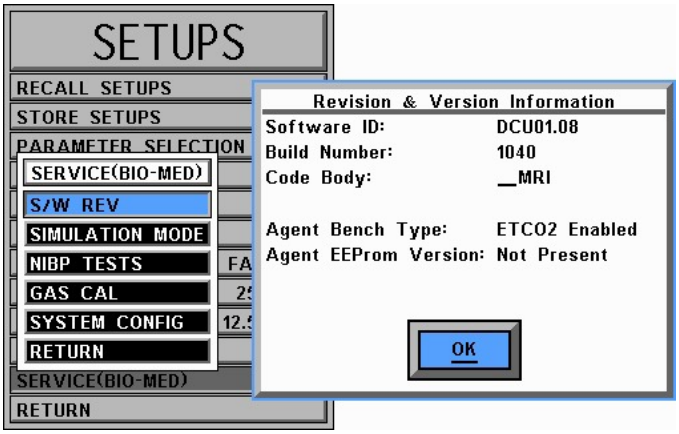

Figure 3-27. Sample DCU Software Revision Screen

WARNING

The Simulation Mode will display real-looking waveforms which are computer generated. The monitor will not monitor patients while in the Simulation Mode. **Do not activate the Simulation Mode with the monitor attached to a patient.** To exit the Simulation Mode, the monitor must be powered Off.

(2) **SIMULATION MODE.** This menu option allows the operator to turn the Simulation Mode ON. (Refer to Page 3-11, paragraph 3.3.1, menu option b(2) for a description of monitor operation in this mode.)

(3) **NIBP TESTS.** Selecting this menu option will bring up the DCU **NIBP TESTS** Menu (Figure 3-28).

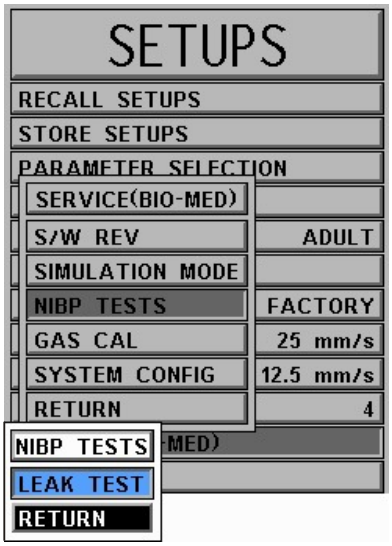

Figure 3-28. DCU NIBP TESTS Menu

The following options are provided in this menu:

(a) **LEAK TEST.** Selecting this menu option will display the **NIBP LEAK TEST** Screen and is identical to the DCU **NIBP TESTS** Menu for the WPU. (Refer to Page 3-13, paragraph 3.3.1, menu option b(3)(b) for a description of the options available in this menu.)

(b) **RETURN.** Selecting this menu option returns the monitor to the Normal Screen.

(4) **GAS CAL.** Selecting this menu option will bring up the DCU **GAS CAL** Menu (Figure 3-29).

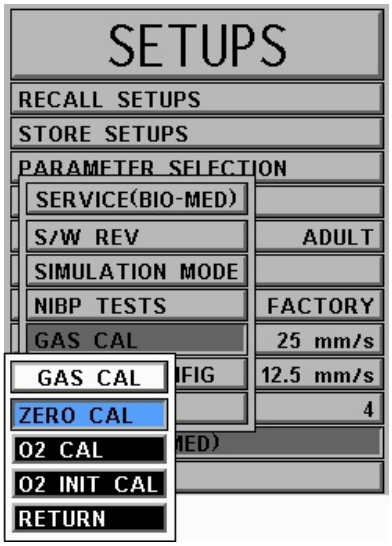

Figure 3-29. DCU GAS CAL Menu

The following menu options are provided in this menu:

(a) **ZERO CAL.** This menu option is identical to **ZERO CAL** for the WPU. (Refer to Page 3-14, paragraph 3.3.1, menu option b(4)(a) for a description of the options available in this menu.)

(b) **O2 CAL.** This menu option is identical to **O2 CAL** for the WPU. (Refer to Page 3-15, paragraph 3.3.1, menu option b(4)(d) for a description of the options available in this menu.)

(c) **O2 INIT CAL.** This menu option is identical to **O2 INIT CAL** for the WPU. (Refer to Page 3-15, paragraph 3.3.1, menu option b(4)(e) for a description of the options available in this menu.)

(d) **RETURN.** Selecting this menu option returns the monitor to the **SERVICE (BIO-MED)** Menu.

(5) **SYSTEM CONFIG**. This menu is brought up by selecting the **SYSTEM CONFIG** Menu option and is identical to the **SYSTEM CONFIG** Menu for the WPU. (Refer to Page 3-17, paragraph 3.3.1, menu option b(6) for a description of the options available in this menu.)

(6) **RETURN.** Selecting this menu option returns the monitor to the **SETUPS** Menu.

f. **Changing the DCU HE119 Network Number.** Refer to Section 8: Page 8-4, paragraph 8.5 for procedures to change the DCU HE119 transceiver Network Number.

SECTION 4
THEORY OF OPERATION

4.0 THEORY OF OPERATION.

NOTE

This manual describes a fully configured monitor, and may include features and/or options that are not included in your monitor. For additional information, contact your local sales representative, or Invivo Customer Service (see Section 1: Page 1-6, paragraph 1.5).

4.1 Introduction. This section contains basic, system-level theory of operation for the **3160** monitor.

4.2 System Overview. (see Figure 4-1) The **3160** system monitors patient vital signs in the MRI magnet room and uses radio telemetry to send this information to remote monitors. It receives patient data using battery powered wireless sensors and conventional sensors.

The AS215 Wireless Processor Unit (WPU) Electronics Assembly is located in the AS239 Base Assembly of the 3160 monitor and will be moved close to the MR magnet in use. It provides patient data processing and radio transceiver communication control.

The AS219 Patient Connection Unit (PCU) is the small box attached to the middle of the MRI pole on the AS239. It provides the means to physically connect sensor cables to the patient. The AS240 Display Control Unit (DCU) Display Assemblies are the stylized boxes containing an LCD parameter display and control panel on the front. These devices are the operator interfaces.

The AS240 can also be detached from its retaining slot at the top of the MRI pole and relocated to the console room for uninterrupted patient vital signs monitoring during MRI scans.

The Wireless ECG and SPO2 patient modules are small (a little larger than a pack of cigarettes) battery operated transmitter modules. They are used to measure basic patient parameters while in the MR bore and transmit the information to the WPU for processing across a radio data link.

The AS201 power adapter is a box that has a country-unique AC power cord on one end and a special power cord on the other end that supplies DC power to the 3160 components. The WPU/DCU Battery Charger is a future option to be used offline in the console room to recharge the large Lithium Ion Battery Packs, while the Patient Module Battery Charger is used to charge the smaller WECG/WSPO2 LI batteries. These battery chargers must NOT be located in the MR magnet room.

In standard operation, ECG and SPO2/RESP patient data is transmitted to the AS215 via patient module radio transceivers. NIBP, IBP, TEMP EtCO2, and Agent IDs are obtained by conventional means via the applicable ports located on the AS219. This data is processed in the AS215, and then transmitted via other radio transceivers to the AS240s for display (see Page 4-3, paragraph 4.4). The human operator uses the control panel on any of the associated DCU's to control local display parameters, and to send master controls to the AS215 to control data processing parameters.

The human operator can also use the AS240 control panel to provide patient parameter selection and control. This data will flow to the AS215 for interpretation, and then control messages are transmitted to the wireless patient modules.

The AS215 also produces and outputs "gating" signals that can be used by the MRI equipment to synchronize to patient body rhythms during MRI scans.

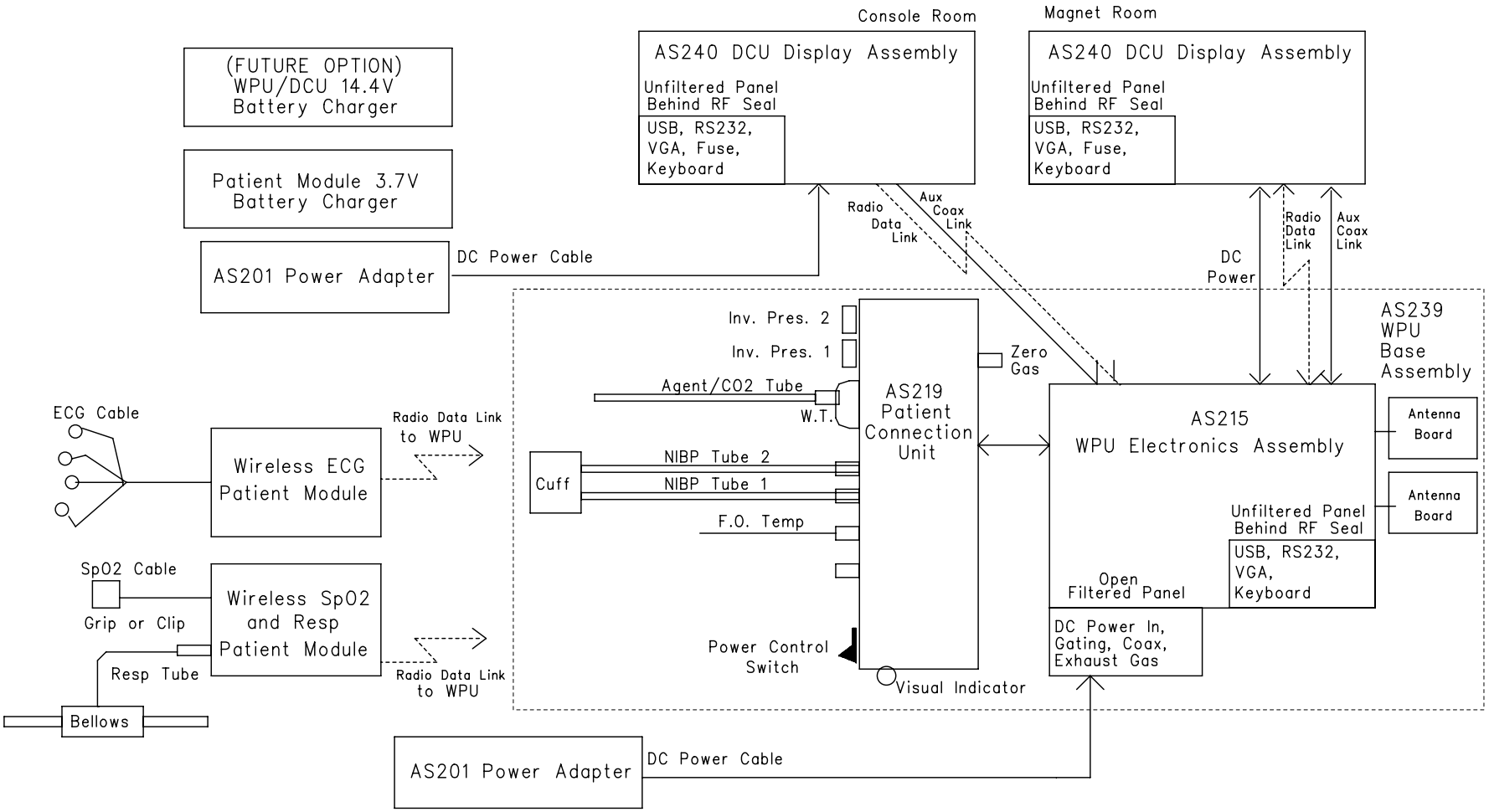

Figure 4-1. 3160 Monitor Overall Block Diagram

There will be a need to reprogram the various **3160** modules from time to time. Reprogramming should only occur when no patient is currently being monitored. The WPU and DCU's are reprogrammed be means of a solid state flash drive via a USB port on each unit. The human operator will simply plug in the flash drive and the unit will find its new software and load it. The patient modules, on the other hand, will be reprogrammed indirectly using the WPU. The WPU will then send the new program information to the patient modules and gating unit via the radio transceivers. The human operator will control which patient modules are updated.

Finally, a need exists to log, and later, output raw data measurements into flash drive devices for later analysis. To meet this need, the ECG and SPO2 patient modules include flash memories large enough to store the required duration of data in real time.

The AS201 Power Adapter, Battery Chargers and PCU are not reprogrammable units.

4.3 Power Distribution. (see Figure 4-2) The AS201 power adapter contains the power supply to convert from universal AC input (47Hz to 63Hz, 85VAC to 264VAC) to isolated +18.3 Vdc. This DC power is current limited to $1.7A_{min}$ - $3.6A_{max}$ inside the power adapter.

NOTE

It is important to ensure that the safety ground is properly connected to the building ground; the power adapter must be attached to something immovable at least 3.3 meters (10 feet) from the MRI magnet.

This DC voltage is the only power input to the WPU or DCU. Each of these units has provision for two +14.4 Vdc Lithium Ion batteries to provide operating power for eight hours or more while disconnected from the power adapter. The power adapter is the means for recharging the batteries online. The recharge time may be up to eight hours for fully discharged batteries with the WPU/DCU powered off, or up to 14 hours with the WPU/DCU powered on. These durations and conditions are subject to future change as the technologies change. As a future option, the WPU/DCU batteries can alternately be recharged offline in the WPU/DCU battery charger located in the console room.

Each WPU and DCU has a DC power input connector for the power adapter cable. If a DCU is attached at the top of the WPU pole, the DCU will get power (+18.3 Vdc) from the MRI pole connector and its external power connector will be disabled.

The WPU and DCU each include a power control switch to turn local power on and off. The WPU power switch is located on the PCU. In both cases the switch merely signals the local power supply with the on/off request; the switches do not directly switch power on or off.

The WECG and WSPO2 patient modules contain a detachable +4.1 Vdc Lithium polymer battery. The battery provides sufficient power for 8 or more hours of operation. These batteries may be recharged offline in the patient module battery charger.

4.4 HE119 (WIT2450) Radio Transceiver. The base HE119 radio located in the WPU transmits patient data to the remote DCU for display and monitoring. The HE119 is a wireless modem that operates in the 2.4 GHz ISM radio frequency band. Each radio transceiver is factory programmed with a unique ID address number to permit optional seamless roaming from access point to access point without the need for re-synchronizing.

With 2.4 GHz Frequency Hopping Spread Spectrum (FHSS) technology, the HE119 radio provides immunity to signal jamming as well as resistance to multipath fading by distributing the transmitted signal over a larger region of the frequency band than would otherwise be necessary to send the information (see Figure 4-3).

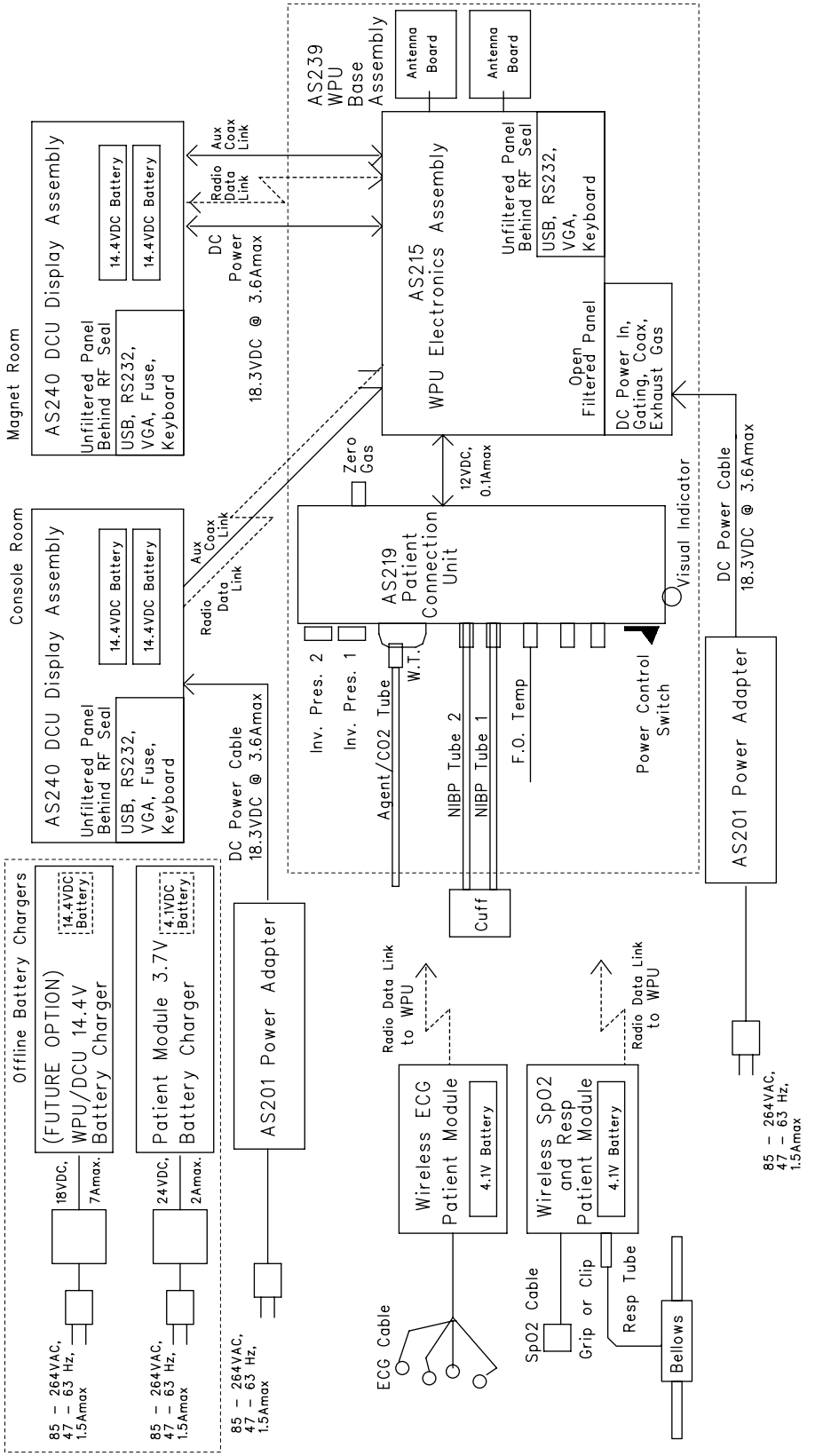

Figure 4-2. Primary Power Distribution Diagram

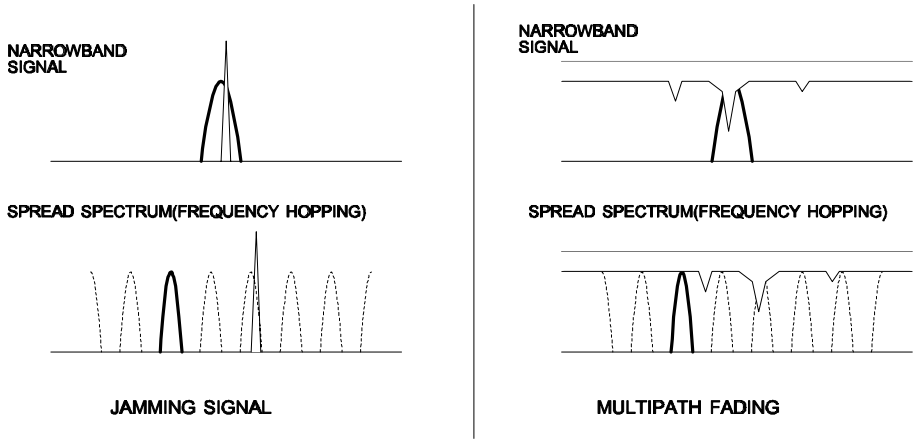

Figure 4-3. Narrowband vs. Spread Spectrum with Interference

The two primary approaches to Spread Spectrum (SS) are Direct Sequence (DS) and Frequency Hopping (FH), either of which can typically be adapted to a given application (see Figure 4-4). Direct Sequence Spread Spectrum (DSSS) is produced by multiplying the transmitted data stream by a much faster, noise-like repeating pattern. The ratio by which this modulation pattern exceeds the bit rate of the baseband data is called the processing gain, and is equal to the amount of rejection the system affords against the narrowband interference from multipath and jammers. Transmitting the data signal as usual, by varying the carrier frequency rapidly over 75 separate channels according to a pseudo-random pattern produces an FHSS.

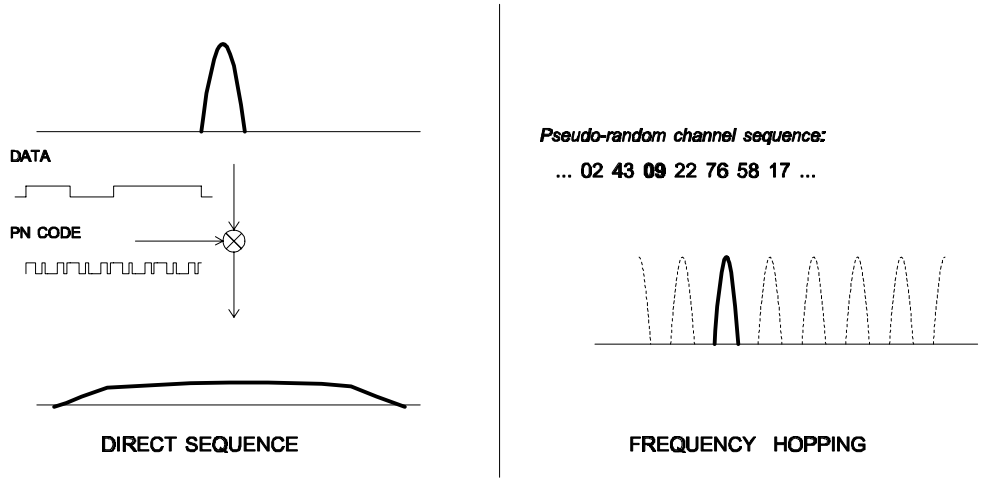

Figure 4-4. Forms of Spread Spectrum Technology

The HE119 radio is capable of continuous RS232 I/O communication rates between 1200 bps and 230.4 kbps with the monitor, and operates at a 460.8 Kbps channel data rate with an RF frequency of 2400 MHz to 2483 MHz and an RF bandwith of 864 KHz. Input supply voltage is adjustable from 3.3 Vdc to 10 Vdc (5 Vdc nominal), and transmit power output is software selectable to either 10 mW, 63 mW or 250 mW.

Radio parameter data (e.g., Data Rate, Transmit Power and Point-to-Point/Point-to-Multipoint modes) can be programmed into the radio on-site by following the instructions provided in Section 8 of this manual.

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SECTION 5
CALIBRATION AND VERIFICATION PROCEDURES

5.0 CALIBRATION AND VERIFICATION PROCEDURES.

5.1 Introduction. The recommended preventive maintenance intervals for the **3160** monitor are provided in Section 7 of this manual. However, anytime repairs are made, options are installed or the monitor fails the Calibration and Verification Procedure in this section, the monitor should be readjusted (see Section 6).

When power to the monitor is removed, a warm-up period of at least 25 minutes should elapse after power is reapplied to the unit, prior to performing any of the calibration/verification procedures provided in this section.

When electrical test points are called out in the procedure, turn power OFF, disconnect the AS201 power connector, remove the backup batteries, then attach the test equipment to the applicable test points before restoring power to the monitor.

5.2 Required Test Equipment. Refer to Section 7: Page 7-1, paragraph 7.2 for a complete list of required test equipment.

5.3 Power Adapter Verification. Perform the following procedure to verify proper operation of the AS201 Power Adapter Assembly.

a. Plug the power cord into a hospital grade AC outlet.

b. Plug the other end of the power cord into the AC Input power connector on the AS201 Power Adapter.

c. Confirm that the green DC OUTPUT indicator on the AS201 front panel is illuminated.

5.4 DCU Verification. (See Figure 5-1) Perform the following procedure to verify the proper operation of the AS240 DCU Assembly.

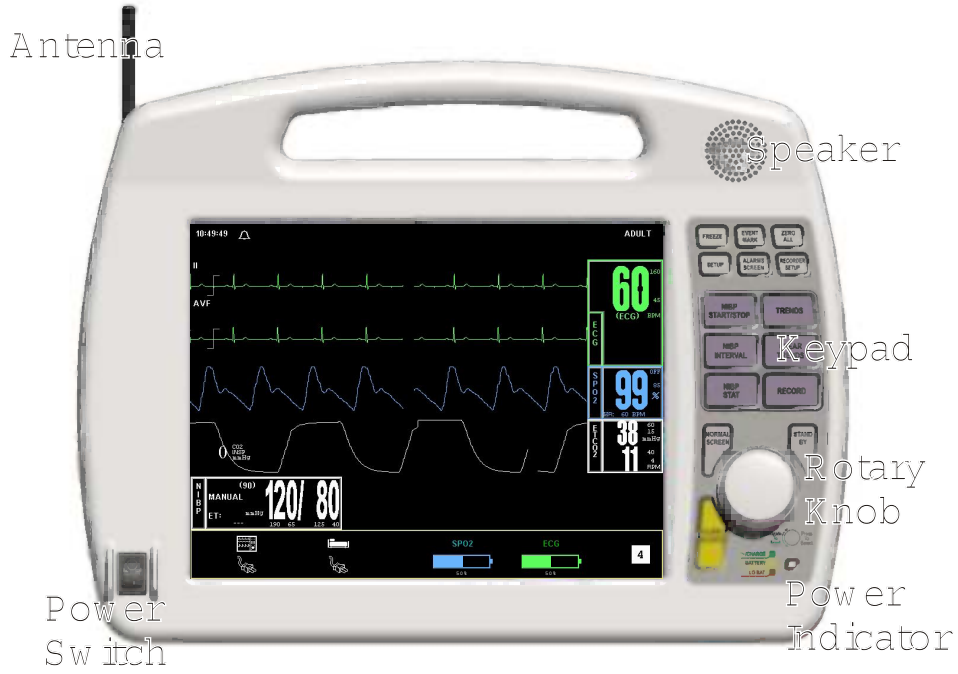


Figure 5-1. DCU Front Panel

5.4.1 Setup - Pretest Inspection. Perform the following to prepare the DCU for calibration and verification.

a. Ensure that the Power Switches on the PCU and DCU are initially set to the OFF ( ) position.

b. Lift the DCU out of the retaining slot at the top of the MRI pole.

c. Connect the AS201 Power Adapter to the DCU and ensure all WPU/DCU batteries are installed.

d. On workbench situated in the same room as the WPU, inspect the AS240 DCU Display Assembly for any external damage (i.e., dents, cracked display, loose or broken connectors/hardware, and legible panel stenciling).

5.4.2 Power Switch and Power Indicator Verification. Perform the following procedure to verify proper operation of the Power Switch and Power Indicator:

a. The DCU Power Indicator flashes green to indicate the presence of +18 Vdc output power from the AS201 Power Adapter.

b. Set the Power Switches on the PCU and DCU to the ON ( ) position (the monitor powers up).

c. The DCU Power Indicator illuminates solid green to indicate that the unit is operating on +18 Vdc output power from the AS201 Power Adapter.

d. Disconnect the AS201 Power Adapter from the DCU.

e. The DCU Power Indicator illuminates solid yellow to indicate that the unit is operating on +14 Vdc output power from the two (2) 9064 backup batteries.

f. Set the Power Switch on the DCU to the OFF ( ) position.

g. The DCU Power Indicator extinguishes to indicate the unit is shut down and no longer operating on battery power.

h. Set the Power Switch on the DCU to the ON ( ) position to power up the monitor on battery power.

i. The DCU Power Indicator returns to a yellow illuminated state (the unit powers up).

j. Set the Power Switch on the PCU to the OFF ( ) position.

NOTE

The DCU Power Indicator will flash to indicate loss of the radio communication link with the HE119 transceiver located in the WPU.

k. When the backup battery input voltage is sufficiently depleted, the DCU Power Indicator changes color from yellow to red and a "WARNING LOW BATTERY" message is displayed to indicate that battery power failure is imminent.

l. The DCU Power Indicator extinguishes upon power failure.

m. Set the Power Switch on the DCU to the OFF ( ) position.

n. Reconnect the AS201 Power Adapter to the DCU.

o. Set the Power Switches on the PCU and DCU to the ON ( ) position (the monitor powers up).

p. The DCU Power Indicator illuminates solid green to indicate facility power has been restored and the backup batteries are recharging.

q. Set the Power Switches on the PCU and DCU to the OFF (⏻) position.

r. Allow the backup batteries to fully recharge (for a minimum of 8 hours).

s. Disconnect the AS201 Power Adapter from the DCU.

5.4.3 Display Verification. Perform the following procedure to verify proper operation of the MDCU display.

a. Reinstall the DCU on the MRI pole with power from the AS201 Power Adapter connected to the WPU and WPU batteries installed.

b. Turn the 3160 monitor ON (perform Section 2: Page 2-2, paragraph 2.5).

c. Confirm a "Normal Screen" (see Section 2: Figure 2-2) with normal colors and hues displayed on the screen.

5.4.4 Control Panel Verification. (See Figure 5-1) Perform the following procedures to verify proper operation of the Rotary Knob and Control Keys on the control panel. (Verification of the control panel's power switch and indicator is included in Page 5-2, paragraph 5.4.2.)

a. Rotary Knob Verification. The Rotary Knob is located to the right of the Display Screen under the Control Keys. This knob performs two functions: rotating (turning) this knob allows the operator to highlight Parameter Icons and, while in a menu, to highlight menu selections; pushing this knob allows the operator to select the highlighted icon or menu item. Perform the following procedure to verify proper operation of the Rotary Knob:

(1) Rotate the knob in the clockwise direction while verifying that the highlight moves from icon to icon with a clockwise movement.

(2) Rotate the knob in the counter clockwise direction while verifying that the highlight moves from icon to icon with a counter clockwise movement.

(3) With any Parameter Icon highlighted, press the knob and verify that the Parameter Menu comes up on the Display Screen.

(4) Rotate the knob in the clockwise direction while verifying that the highlight moves from selection to selection with a top to bottom movement.

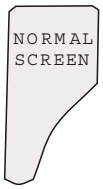
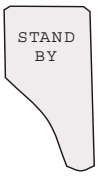
(5) Rotate the knob in the counter clockwise direction while verifying that the highlight moves from selection to selection with a bottom to top movement.

(6) Highlight the **RETURN** menu item, press the knob and verify that the menu is removed from the Display Screen.

b. Control Key Verification. The Control Keys are located on the Keypad to the right of the Display Screen. Pressing certain Control Keys will open a function menu then, with the Rotary Knob, menu items may be selected and executed within the opened menu. Perform the following steps to verify proper operation of the Control Keys:

Button	Step	
	(1)	Verify the **FREEZE** Control Key as follows:
		(a) Press the **FREEZE** Control Key.
		(b) Observe that the display screen Trace A "Freezes" in Trace B location.
		(c) Press the **FREEZE** Control Key.
		(d) Observe that the display screen trace resumes its movement.
	(2)	(If the Recorder option is installed) Verify the **EVENT MARK** Control Key as follows:
		(a) Press the **EVENT MARK** Control Key.
		(b) Observe that a marker is printed on the ECG recorder strip when the recorder is running. (If the printer is not running, pressing this key has no effect.)
	(3)	Verify the **ZERO ALL** Control Key as follows:
		(a) Press the **ZERO ALL** Control Key.
		(b) A dialog box is displayed to alert the operator that no invasive pressures are enabled.
	(4)	Verify the **SETUP** Control Key as follows:
		(a) Press the **SETUP** Control Key.
		(b) Observe that the **SETUPS** Menu is displayed.
		(c) Press the **NORMAL SCREEN** Control Key.
		(d) Observe that the **SETUPS** Menu is removed from the display.
	(5)	Verify the **ALARMS SCREEN** Control Key as follows:
		(a) Press the **ALARMS SCREEN** Control Key.
		(b) Observe that the **ALARMS** Menu is displayed.
		(c) Press the **NORMAL SCREEN** Control Key.
		(d) Observe that the **ALARMS** Menu is removed from the display.
	(6)	(If the Recorder option is installed) Verify the **RECORDER SETUP** Control Key as follows:
		(a) Press the **RECORDER SETUP** Control Key.
		(b) Observe that the **RECORDER** Menu is displayed.
		(c) Press the **NORMAL SCREEN** Control Key.
		(d) Observe that the **RECORDER** Menu is removed from the display.

Button	Step	
NIBP START/STOP	(7)	Verify the **NIBP START/STOP** Control Key as follows:
		(a) Connect an NIBP Cuff to the Sense and Inflate Ports on the monitor front panel.
		(b) Press the **NIBP START/STOP** Control Key.
		(c) Observe that the monitor attempts to take an NIBP measurement.
		(d) Press the **NIBP START/STOP** Control Key.
		(e) Observe that the NIBP Pressure Pump turns off.
NIBP INTERVAL	(8)	Verify **NIBP INTERVAL** Control Key as follows:
		(a) Press the **NIBP INTERVAL** Control Key.
		(b) Observe that the **INTERVAL** Menu is displayed.
		(c) Press the **NORMAL SCREEN** Control Key.
		(d) Observe that the **INTERVAL** Menu is removed from the display.
NIBP STAT	(9)	Verify the **NIBP STAT** Control Key as follows:
		(a) Press the **NIBP STAT** Control Key.
		(b) Observe that the monitor attempts to take an NIBP measurement.
		(c) Press the **NIBP START/STOP** Control Key.
		(d) Observe that the NIBP Pressure Pump turns off.
TRENDS	(10)	Verify the **TRENDS** Control Key as follows:
		(a) Press the **TRENDS** Control Key.
		(b) Observe that the **HISTORY** Menu is displayed.
		(c) Press the **NORMAL SCREEN** Control Key.
		(d) Observe that the **HISTORY** Menu is removed from the display.
CLEAR TRENDS	(11)	Verify the **CLEAR TRENDS** Control Key as follows:
		(a) Press the **CLEAR TRENDS** Control Key.
		(b) Turn the Rotary Knob to highlight the **YES** menu selection.
		(c) Press the Rotary Knob to select **YES**.
		(d) Observe the **WARNING** prompt is removed from the display and all trend and patient data are erased.
RECORD	(12)	(If the Recorder option is installed) Verify the **RECORD** Control Key as follows:
		(a) Press the **RECORD** Control Key.
		(b) Observe that the printer (on the DCU left side panel) begins to print.
		(c) Press the **RECORD** Control Key.
		(d) Observe that the printout is aborted (this is not immediately apparent as a Patient Information Area is printed before the printer actually stops).

Button	Step
	(13) Verify the **NORMAL SCREEN** Control Key as follows: (a) Press the **NORMAL SCREEN** Control Key. (b) Observe that pressing this Control Key returns the monitor to the "Normal Screen" when any menu is displayed. (Pressing this key has no effect if no menu is displayed.)
	(14) Verify the **STANDBY** Control Key as follows: (a) Press the **STANDBY** Control Key. (b) Observe that all audible alarms are disabled, the disabled alarms are indicated on the display screen by an "X" through the bell shaped Alarm Status Symbol, and active NIBP automatic measurements are suspended. (c) Press the **STANDBY** Control Key a second time. (d) Observe that all audible alarms are enabled, the "X" through the bell shaped Alarm Status Symbol is removed, and active NIBP automatic measurements are resumed after selection of the **NIBP START/ STOP** Control Key.
	(15) Verify the **ALARM SILENCE** Control Key as follows: (a) Press the **ALARM SILENCE** Control Key. (b) Observe that pressing this Control Key stops the alarm tone when an alarm is active. (Pressing this key has no effect when audio alarms are disabled.)

5.4.5 Sound System Verification and Adjustment. Perform the following procedure to verify and adjust the volume level of the Alarm Tone, Pulse Tone or the Click Tone:

a. Access the **SOUND ADJUST** Menu as follows:

(1) Press the **SETUP** Control Key.

(2) Use the Rotary Knob to highlight the **SOUND ADJUST** menu selection.

(3) Press the Rotary Knob.

(4) Use the Rotary Knob to highlight the **ALARMS** menu selection.

(5) Press the Rotary Knob.

(6) Use the Rotary Knob to highlight the **OFF** selection.

(7) Press the Rotary Knob.

b. Verify and adjust the Alarm Tone Volume as follows:

(1) Use the Rotary Knob to highlight the **ALARM VOLUME** menu selection.

(2) Press the Rotary Knob.

(3) Use the Rotary Knob to highlight the various Volume settings, pressing the knob at each one to verify that the volume level changes.

(4) Use the Rotary Knob to highlight 4.

(5) Press the Rotary Knob.

(6) Scroll to the **DONE** menu selection and press the Rotary Knob.

c. Verify and adjust the Pulse Tone Volume as follows:

(1) Use the Rotary Knob to highlight the **PULSE VOLUME** menu selection.

(2) Press the Rotary Knob.

(3) Use the Rotary Knob to highlight the various Volume settings, pressing the knob at each one to verify that the volume level changes.

(4) Use the Rotary Knob to highlight 4.

(5) Press the Rotary Knob.

(6) Scroll to the **DONE** menu selection and press the Rotary Knob.

d. Verify and adjust the Click Tone Volume as follows:

(1) Use the Rotary Knob to highlight the **CLICK TONE** menu selection.

(2) Press the Rotary Knob and verify click tone is set to **ON**, then highlight and select the **RETURN** menu selection.

(3) Use the Rotary Knob to highlight the **CLICK VOLUME** menu selection.

(4) Press the Rotary Knob.

(5) Use the Rotary Knob to highlight the various Volume settings, pressing the knob at each one to verify that the volume level changes.

(6) Use the Rotary Knob to highlight 4.

(7) Press the Rotary Knob.

(8) Scroll to the **DONE** menu selection and press the Rotary Knob.

e. Exit by pressing the **NORMAL SCREEN** Control Key.

5.4.6 Time Set Verification. Perform the following procedure to verify and adjust the Time Setting of this monitor.

a. Press the **SETUP** Control Key.

b. Use the Rotary Knob to highlight the **SET TIME** menu selection.

c. Press the Rotary Knob to select the **SET TIME** Menu.

d. Verify the 12 and 24 hour clocks as follows:

(1) Turn the Rotary Knob to highlight the **FORMAT** menu selection.

(2) Press the Rotary Knob to select **FORMAT**.

(3) Turn the Rotary Knob to toggle the clock from 24 to 12 hour while observing that the **HOUR** menu selection also toggles to reflect the format change.

(4) Turn the Rotary Knob until the desired setting is displayed then press the knob to accept the setting.

e. Verify the Seconds adjustment as follows:

(1) Turn the Rotary Knob to highlight the **SECOND** menu selection.

(2) Press the Rotary Knob to select **SECOND**.

(3) Turn the Rotary Knob until the correct **SECOND** is displayed.

(4) Press the Rotary Knob to accept the **SECOND** setting.

f. Verify the Minutes adjustment as follows:

(1) Turn the Rotary Knob to highlight the **MINUTE** menu selection.

(2) Press the Rotary Knob to select **MINUTE**.

(3) Turn the Rotary Knob until the correct **MINUTE** is displayed.

(4) Press the Rotary Knob to accept the **MINUTE** setting.

g. Verify the Hours adjustment as follows:

(1) Turn the Rotary Knob to highlight the **HOUR** menu selection.

(2) Press the Rotary Knob to select **HOUR**.

(3) Turn the Rotary Knob until the correct **HOUR** is displayed.

(4) Press the Rotary Knob to accept the **HOUR** setting.

h. Verify the Day adjustment as follows:

(1) Turn the Rotary Knob to highlight the **DAY** menu selection.

(2) Press the Rotary Knob to select **DAY**.

(3) Turn the Rotary Knob until the correct **DAY** is displayed.

(4) Press the Rotary Knob to accept the **DAY** setting.

i. Verify the Month adjustment as follows:

(1) Turn the Rotary Knob to highlight the **MONTH** menu selection.

(2) Press the Rotary Knob to select **MONTH**.

(3) Turn the Rotary Knob until the correct **MONTH** is displayed.

(4) Press the Rotary Knob to accept the **MONTH** setting.

j. Verify the Year adjustment as follows:

(1) Turn the Rotary Knob to highlight the **YEAR** menu selection.

(2) Press the Rotary Knob to select **YEAR**.

(3) Turn the Rotary Knob until the correct **YEAR** is displayed.

(4) Press the Rotary Knob to accept the **YEAR** setting.

k. Turn the Rotary Knob to highlight the **ENTER** menu selection.

l. Press the Rotary Knob to save the changes performed.

m. Turn the Rotary Knob to highlight the **RETURN** menu selection.

n. Press the Rotary Knob to return to the **SETUPS** Menu.

o. Press the **NORMAL SCREEN** Control Key to return the monitor to the operational display.

5.4.7 Store and Recall Setups Verification. Perform the following procedure to verify the proper operation of the Store and Recall Setups feature (performing this test may change all stored setups):

a. Press the **SETUP** Control Key.

b. Turn the Rotary Knob to highlight the **PARAMETER** menu selection.

c. Press the Rotary Knob to select **PARAMETER**.

d. Turn the Rotary Knob to highlight the **AGENTS** selection.

e. Press the Rotary Knob to select **AGENTS**.

f. Turn the Rotary Knob to highlight the **ON** menu selection.

g. Press the Rotary Knob to select **ON**.

h. Press the **SETUP** Control Key.

i. Turn the Rotary Knob to select the **STORE SETUPS** menu selection.

j. Press the Rotary Knob to select **STORE SETUPS**.

k. Turn the Rotary Knob to highlight the **A** menu selection.

l. Press the Rotary Knob to select **A**.

m. Turn the Rotary Knob to highlight the **YES** menu selection.

n. Press the Rotary Knob to select **YES**.

o. Toggle the DCU Power Switch OFF, then back ON after 5 seconds.

p. Once the Normal Screen appears, press the **SETUP** Control Key.

q. Turn the Rotary Knob to highlight the **RECALL SETUPS** menu selection.

r. Press the Rotary Knob to select **RECALL SETUPS**.

s. Turn the Rotary Knob to highlight the **A** menu selection.

t. Press the Rotary Knob to select **A**.

u. Turn the Rotary Knob to highlight the **YES** menu selection.

v. Press the Rotary Knob to select **YES**.

w. Verify the presence of the EtCO2 and AGENTS icons on the display.

5.4.8 Cold Start Verification. Perform the following procedure to verify the proper operation of the Cold Start feature:

a. Cold start the DCU (see Section 7: Page 7-11, paragraph 7.6).

b. When the Normal Screen is displayed, press the **SETUP** Control Key.

c. Turn the Rotary Knob to highlight the **RECALL SETUPS** menu selection.

d. Press the Rotary Knob to select **RECALL SETUPS**.

e. Turn the Rotary Knob to highlight the **A** menu selection.

f. Press the Rotary Knob to select **A**.

g. Turn the Rotary Knob to highlight the **YES** menu selection.

h. Press the Rotary Knob to select **YES**.

i. Verify Cold Start by the absence of the EtCO2 and AGENTS icons on the display.

5.4.9 Recorder Verification. (If the Recorder option is installed) Perform the following procedure to verify proper operation of the monitors printing system:

a. Connect an ECG Patient Simulator to the ECG input on the PCU front panel.

b. Set the Patient Simulator to output a 1 mV square wave at 2 Hz.

c. Setup the ECG as follows:

(1) Turn the Rotary Knob to highlight the ECG Icon.

(2) Press the Rotary Knob to bring up the **ECG** Menu.

(3) Turn the Rotary Knob to highlight the **TRACE A LEAD** menu selection.

(4) Press the Rotary Knob to select **TRACE A LEAD**.

(5) Turn the Rotary Knob to highlight the **II** menu selection.

(6) Press the Rotary Knob to select lead **II**.

(7) Turn the Rotary Knob to highlight the **FILTER MODE** menu selection.

(8) Press the Rotary Knob to bring up the **FILTER MODE** Menu.

(9) Turn the Rotary Knob to highlight the **MON** menu selection.

(10) Press the Rotary Knob to select **MON**.

(11) Turn the Rotary Knob to highlight the **SCALE** menu selection.

(12) Press the Rotary Knob to bring up the **SCALE** Menu.

(13) Turn the Rotary Knob to highlight the **10 mm/mV** menu selection.

(14) Press the Rotary Knob to select **10 mm/mV**.

d. Setup the Recorder as follows:

(1) Press the **RECORDER SETUP** Control Key.

(2) Turn the Rotary Knob to highlight the **TRACE 1** menu selection.

(3) Press the Rotary Knob to select **TRACE 1**.

(4) Turn the Rotary Knob to highlight the **ECG 1** menu selection.

(5) Press the Rotary Knob to select **ECG 1**.

(6) Turn the Rotary Knob to highlight the **TRACE 2** menu selection.

(7) Press the Rotary Knob to select **TRACE 2**.

(8) Turn the Rotary Knob to highlight the **OFF** menu selection.

(9) Press the Rotary Knob to select **OFF**.

(10) Turn the Rotary Knob to highlight the **SWEEP SPEED** menu selection.

(11) Press the Rotary Knob to select **SWEEP SPEED**.

(12) Turn the Rotary Knob to highlight the **25 mm/s** menu selection.

(13) Press the Rotary Knob to select **25 mm/s**.

e. Press the **RECORD** Control Key, wait five (5) seconds and press the **RECORD** Control Key a second time.

f. Verify the following:

(1) The paper comes out smoothly with all printing performed clearly.

(2) The printout has a deflection of 10 mm (2 blocks) ±1mm.

(3) Verify that the LO speed printout is a full cycle of 15 mm (2.5 blocks) ±1 mm.

g. Setup the Recorder as follows:

(1) Press the **RECORDER SETUP** Control Key.

(2) Turn the Rotary Knob to highlight the **SWEEP SPEED** menu selection.

(3) Press the Rotary Knob to select **SWEEP SPEED**.

(4) Turn the Rotary Knob to highlight the **50 mm/s** menu selection.

(5) Press the Rotary Knob to select **50 mm/s**.

h. Press the **RECORD** Control Key, wait five (5) seconds and press the **RECORD** Control Key a second time.

i. Verify that the HI speed printout is a full cycle of 30 mm (5 blocks) ±1 mm.

j. Setup the Recorder as follows:

(1) Press the **RECORDER SETUP** Control Key.

(2) Turn the Rotary Knob to highlight the **SWEEP SPEED** menu selection.

(3) Press the Rotary Knob to select **SWEEP SPEED**.

(4) Turn the Rotary Knob to highlight the **25 mm/s** menu selection.

(5) Press the Rotary Knob to select **25 mm/s**.

k. Press the **NORMAL SCREEN** Control Key.

l. Disconnect the Patient Simulator from the PCU.

5.5 PCU Verification. Perform the following procedure to verify the proper operation of the AS219 PCU Assembly.

5.5.1 Setup - Pretest Inspection. Perform the following to prepare the AS219 PCU for calibration and verification.

a. Connect the monitor to power (perform Section 2: Page 2-1, paragraph 2.4) with power from the AS201 Power Adapter connected to the WPU and WPU/DCU batteries installed.

b. Inspect the PCU assembly for any external damage (i.e., dents, cracks, loose or broken connectors/hardware, and legible panel stenciling).

5.5.2 Power Switch and Status Indicator Verification. Perform the following procedure to verify proper operation of the Power Switch and Status Indicator:

a. The PCU Status Indicator flashes green to indicate the presence of +18 Vdc output power from the AS201 Power Adapter.

b. Set the Power Switches on the PCU and DCU to the ON (⊙) position (the monitor powers up).

c. The PCU Status Indicator illuminates solid green to indicate that the unit is operating on +18 Vdc output power from the AS201 Power Adaptor.

d. Disconnect the AS201 Power Adapter from the WPU.

e. The PCU Status Indicator illuminates solid yellow to indicate that the monitor is operating on +14 Vdc output power from the two (2) 9064 backup batteries.

f. Set the Power Switch on the PCU to the OFF (⏻) position.

g. The PCU Status Indicator extinguishes to indicate the unit is shut down and no longer operating on battery power.

h. Set the Power Switch on the PCU to the ON (⊙) position to power up the unit on battery power.

i. The PCU Status Indicator returns to a yellow illuminated state (the unit powers up).

j. Set the Power Switch on the DCU to the OFF (⏻) position.

NOTE

The PCU Status Indicator will flash to indicate loss of the radio communication link with the HE119 transceiver located in the DCU.

k. When the backup battery input voltage is sufficiently depleted, the PCU Status Indicator changes color from yellow to red to indicate that battery power failure is imminent.

l. The PCU Status Indicator extinguishes upon power failure.

m. Set the Power Switch on the PCU to the OFF (⏻) position.

n. Reconnect the AS201 Power Adapter to the WPU.

o. Set the Power Switches on the PCU and DCU to the ON (⊙) position (the monitor powers up).

p. The PCU Status Indicator illuminates solid green to indicate facility power has been restored and the backup batteries are recharging.

q. Set the Power Switch on the PCU and DCU to the OFF (⏻) position.

r. Allow the backup batteries to fully recharge (for a minimum of 8 hours) before returning to operation.

5.5.3 Invasive Blood Pressure Verification. (If the Invasive Blood Pressure option is installed) Perform the following procedure to verify the proper operation of the IBP monitoring system:

a. Turn the 3160 monitor ON (perform Section 2: Page 2-2, paragraph 2.5).

b. Connect the output of a Pressure Simulator to the P1/D1 connector on the PCU.

c. Set the Pressure Simulator to output 000 mmHg with the Zero switch on (center position).

d. On the DCU, turn on P1 as follows:

(1) Press the **SETUP** Control Key.

(2) Turn the Rotary Knob to highlight the **PARAMETER SELECTION** menu selection.

(3) Press the Rotary Knob to select **PARAMETER SELECTION**.

(4) Turn the Rotary Knob to highlight the **P1** parameter selection.

(5) Press the Rotary Knob to select **P1.**

(6) Turn the Rotary Knob to highlight the **ON** menu selection.

(7) Press the Rotary Knob to select **ON**.

(8) Press the **NORMAL SCREEN** Control Key.

e. On the DCU, setup Invasive Pressure 1 as follows:

(1) Turn the Rotary Knob to highlight the P1 Icon.

(2) Press the Rotary Knob to bring up the **P1** Menu.

(3) Press the Rotary Knob to select the **ZERO SET** menu selection.

(4) Verify successful zeroing of Pressure Channel 1.

(5) Press the Rotary Knob to select OK.

f. Verify the P1 numerics indicate Zero ±1 count.

g. Press the **NORMAL SCREEN** Control Key.

h. Adjust the Pressure Simulator as follows:

(1) Set the Pressure Simulator Zero switch to "+."

(2) Set the Pressure Simulator to output 240.

i. Verify that the P1 numerics increase in a positive direction toward 240.

j. Set the Pressure Simulator Zero switch to Zero.

k. Verify that the P1 numerics return to zero.

l. Verify the Invasive Pressure at different levels as follows:

(1) Set the Pressure Simulator Zero switch to "+."

(2) Set the Pressure Simulator to output 50.

(3) Verify that the P1 numerics indicate 50 ±1.

(4) Set the Pressure Simulator to output 100.

(5) Verify that the P1 numerics indicate 100 ±1.

(6) Set the Pressure Simulator to output 150.

(7) Verify that the P1 numerics indicate 150 ±1.

(8) Set the Pressure Simulator to output 200.

(9) Verify that the P1 numerics indicate 200 ±1.

(10) Set the Pressure Simulator to output 240.

(11) Verify that the P1 numerics indicate 240 ±1.

(12) Set the Pressure Simulator to output 250.

(13) Verify that the P1 numerics indicate 250 alternating with the "OVR" message.

m. Repeat substeps "b" through "l" for P2/D2.

5.6 WPU Verification. Perform the following procedure to verify the proper operation of the AS215 WPU Electronics Assembly.

5.6.1 Setup - Pretest Inspection. Perform the following to prepare the AS215 WPU for calibration and verification.

a. Connect the monitor to power (perform Section 2: Page 2-1, paragraph 2.4) with power from the AS201 Power Adapter connected to the WPU and WPU batteries installed.

b. Turn the 3160 monitor ON (perform Section 2: Page 2-2, paragraph 2.5).

c. Inspect the WPU for any external damage (i.e., dents, cracks, loose or broken connectors/hardware, and legible panel stenciling).

5.6.2 ECG Verification. Perform the following procedure to verify proper operation of the standard Wireless, or alternate Fiber Optic (F.O.), ECG system:

a. Insert a fully charged battery pack into the WECG transmitter. Attach the ECG leads on the WECG transmitter to the ECG Patient Simulator terminals as indicated in Table 5-1 below:

Table 5-1. Patient Simulator ECG Lead Attachments

ECG Lead(s)	Patient Simulator Terminals
Green	RL
White	RA
Black	LA
Red	LL

b. Set the Patient Simulator to output a 0.5mV QRS pulse at 60 BPMs (NORMAL SINUS mode).

c. Setup the ECG as follows:

(1) Turn the Rotary Knob to highlight the ECG Icon.

(2) Press the Rotary Knob to bring up the **ECG** Menu.

(3) Turn the Rotary Knob to highlight the **TRACE A LEAD** menu selection.

(4) Press the Rotary Knob to select **TRACE A LEAD**.

(5) Turn the Rotary Knob to highlight the **II** menu selection.

(6) Press the Rotary Knob to select lead **II**.

(7) If Dual Lead ECG is installed, perform the following:

(a) Turn the Rotary Knob to highlight the **TRACE B LEAD** menu selection.

(b) Press the Rotary Knob to select **TRACE B LEAD**.

(c) Turn the Rotary Knob to highlight the **OFF** menu selection.

(d) Press the Rotary Knob to select **OFF**.

(8) Turn the Rotary Knob to highlight the **FILTER MODE** menu selection.

(9) Press the Rotary Knob to bring up the **FILTER MODE** Menu.

(10) Turn the Rotary Knob to highlight the **MON** menu selection.

(11) Press the Rotary Knob to select **MON**.

(12) Turn the Rotary Knob to highlight the **SCALE** menu selection.

(13) Press the Rotary Knob to bring up the **SCALE** Menu.

(14) Turn the Rotary Knob to highlight the **10 mm/mV** menu selection.

(15) Press the Rotary Knob to select **10 mm/mV**.

(16) Turn the Rotary Knob to highlight the **HR TONE SRCE** menu selection.

(17) Press the Rotary Knob to bring up the **HR TONE SRCE** Menu.

(18) Turn the Rotary Knob to highlight the **QRS** menu selection.

(19) Press the Rotary Knob to select **QRS**.

(20) Press the **NORMAL SCREEN** Control Key.

d. Verify the following:

(1) Trace A shows a waveform train of moving QRS pulses without jittering.

(2) Trace A numerics indicate an ECG count of 60 ±1 BPM.

(3) The QRS Symbol (flashing heart) is present.

(4) QRS Heart Rate Tone is present with NO double tones.

e. Set the Patient Simulator to output a 2 mV QRS pulse at 60 BPMs.

f. Verify the following:

(1) Trace A shows a waveform train of moving QRS pulses without jittering.

(2) Trace A numerics indicate an ECG count of 60 ±1 BPM.

(3) The QRS Symbol (flashing heart) is present.

(4) QRS Heart Rate Tone is present with NO double tones.

g. Set the Patient Simulator to output a 2 mV QRS pulse at 120 BPMs.

h. Verify the following:

(1) Trace A shows a waveform train of moving QRS pulses without jittering.

(2) Trace A numerics indicate an ECG count of 120 ±1 BPM.

(3) The QRS Symbol (flashing heart) is present.

(4) QRS Heart Rate Tone is present with NO double tones.

i. Set the Patient Simulator to output a 2 mV QRS pulse at 240 BPMs.

j. Verify the following:

(1) Trace A shows a waveform train of moving QRS pulses without jittering.

(2) Trace A numerics indicate an ECG count of 240 ±5 BPMs.

(3) The QRS Symbol (flashing heart) is present.

(4) QRS Heart Rate Tone is present with NO double tones.

k. Set the Patient Simulator to output a 2 mV QRS pulse at 300 BPMs.

l. Verify lead **II** alternately flashes "**250**" and "**OVR**."

m. Turn the Rotary Knob to highlight the ECG Icon.

n. Press the Rotary Knob to bring up the **ECG** Menu.

o. Turn the Rotary Knob to highlight the **CALIBRATE** menu selection.

p. Press the Rotary Knob to select **ECG**.

q. Verify a calibration waveform on Trace A at a rate of 1 mV at 1 Hz and 10% duty cycle.

r. Press the Rotary Knob to select **OFF**.

s. Confirm lead **II** is selected for **TRACE A LEAD**.

t. Set Patient Simulator to output a 1 mV square wave at 2 Hz (240 BPMs).

u. Verify an ECG count of 240 ±5 BPMs.

v. Set the Patient Simulator to output a 1.5 mV QRS pulse at 60 BPMs.

w. Disconnect the Patient Simulator from the WECG transmitter.

x. **ECG Lead Fail Verification (Trace A).** Perform the following procedure to verify proper operation of the ECG Lead Fail Circuitry:

(1) Connect an ECG Patient Simulator to the WECG transmitter leads (see Page 5-13, Table 5-1).

(2) Set the Patient Simulator to output a 1.5 mV QRS pulse at 60 BPMs (NORMAL SINUS mode).

(3) Select ECG lead **I** for **TRACE A LEAD**.

(4) If "NEO" is displayed above the ECG icon on the DCU display, change the Patient Mode to Adult as follows:

(a) Press the **SETUP** Control Key.

(b) Turn the Rotary Knob to highlight the **PATIENT** menu selection.

(c) Press the Rotary Knob to select **PATIENT**.

(d) Turn the Rotary Knob to highlight the **ADULT** menu selection.

(e) Press the Rotary Knob to select **ADULT**.

(f) Press the **NORMAL SCREEN** Control Key.

(5) Remove one wire at a time (that pertains to the selected lead) until all the lead wires have been tested (see Page 5-13, Table 5-1). In each case verify that **within 25 seconds** of removal of each wire that the "**LEAD FAIL**" message appears to the right of the selected lead at the top left of the display screen and that there is no QRS Tone or Number displayed. Verify that the trace recovery time is within 25 seconds of Lead Fail Correction.

(6) Select each lead in order and perform substep "5" until all the leads have been verified. Refer to Table 5-2 below for correct ECG Trace A/B Lead and ECG Patient Simulator Terminal selections:

Table 5-2. Patient Simulator Terminal Selections

ECG Trace A/B Lead(s)	Patient Simulator Terminals
I	RA, LA
II	RA, LL
III	LA, LL
AVL, AVR, AVF	RA, LA, LL

(7) Disconnect the Patient Simulator from the ECG transmitter.

y. **ECG Neonate Sensitivity Verification (Trace A).** Perform the following procedure to verify proper operation of the ECG Neonatal Circuitry:

(1) Connect an ECG Patient Simulator to the ECG transmitter leads (see Page 5-13, Table 5-1).

(2) Set the Patient Simulator to output a 0.15 mV QRS pulse at 80 BPMs.

(3) Select ECG Lead III as follows:

(a) Turn the Rotary Knob to highlight the ECG Icon.

(b) Press the Rotary Knob to bring up the **ECG** Menu.

(c) Turn the Rotary Knob to highlight the **TRACE A LEAD** menu selection.

(d) Press the Rotary Knob to select **TRACE A LEAD**.

(e) Turn the Rotary Knob to highlight the **III** menu selection.

(f) Press the Rotary Knob to select lead **III**.

(g) Press the **NORMAL SCREEN** Control Key.

(4) Verify that, while still in Adult Mode, there is no QRS Tone and 0 BPM is displayed.

(5) Change the Patient Mode as follows:

(a) Press the **SETUP** Control Key.

(b) Turn the Rotary Knob to highlight the **PATIENT** menu selection.

(c) Press the Rotary Knob to select **PATIENT**.

(d) Turn the Rotary Knob to highlight the **NEO** menu selection.

(e) Press the Rotary Knob to select **NEO**.

(f) Press the **NORMAL SCREEN** Control Key.

(6) Verify a QRS count of "80," ±1 a flashing heart symbol and audible tone, and no **LEAD FAIL** message in the ECG message area.

(7) Set the Patient Simulator to output a 1.0 mV QRS pulse at 60 BPMs.

(8) Change the Patient Mode as follows:

(a) Press the **SETUP** Control Key.

(b) Turn the Rotary Knob to highlight the **PATIENT** menu selection.

(c) Press the Rotary Knob to select **PATIENT**.

(d) Turn the Rotary Knob to highlight the **ADULT** menu selection.

(e) Press the Rotary Knob to select **ADULT**.

(f) Press the **NORMAL SCREEN** Control Key.

(9) Select ECG Lead II as follows:

(a) Turn the Rotary Knob to highlight the ECG Icon.

(b) Press the Rotary Knob to bring up the **ECG** Menu.

(c) Turn the Rotary Knob to highlight the **TRACE A LEAD** menu selection.

(d) Press the Rotary Knob to select **TRACE A LEAD**.

(e) Turn the Rotary Knob to highlight the **II** menu selection.

(f) Press the Rotary Knob to select lead **II**.

(g) Press the **NORMAL SCREEN** Control Key.

(10) Disconnect the Patient Simulator and ECG transmitter.

z. **Dual ECG Verification (Trace B).** (If the Dual ECG option is installed) Perform the following procedure to verify proper operation of the Dual Lead ECG system:

(1) Insert a fully charged battery pack into the ECG transmitter. Attach the ECG leads on the WECG transmitter to the ECG Patient Simulator terminals as indicated in Page 5-13, Table 5-1.

(2) Set the Patient Simulator to output a 0.5mV QRS pulse at 60 BPMs (NORMAL SINUS mode).

(3) Setup the ECG as follows:

(a) Turn the Rotary Knob to highlight the ECG Icon.

(b) Press the Rotary Knob to bring up the **ECG** Menu.

(c) Turn the Rotary Knob to highlight the **TRACE A LEAD** menu selection.

(d) Press the Rotary Knob to select **TRACE A LEAD**.

(e) Turn the Rotary Knob to highlight the **OFF** menu selection.

(f) Press the Rotary Knob to select lead **OFF**.

(g) Turn the Rotary Knob to highlight the **TRACE B LEAD** menu selection.

(h) Press the Rotary Knob to select **TRACE B LEAD**.

(i) Turn the Rotary Knob to highlight the **II** menu selection.

(j) Press the Rotary Knob to select **II**.

(k) Turn the Rotary Knob to highlight the **FILTER MODE** menu selection.

(l) Press the Rotary Knob to bring up the **FILTER MODE** Menu.

(m) Turn the Rotary Knob to highlight the **MON** menu selection.

(n) Press the Rotary Knob to select **MON**.

(o) Turn the Rotary Knob to highlight the **SCALE** menu selection.

(p) Press the Rotary Knob to bring up the **SCALE** Menu.

(q) Turn the Rotary Knob to highlight the **10 mm/mV** menu selection.

(r) Press the Rotary Knob to select **10 mm/mV**.

(s) Turn the Rotary Knob to highlight the **HR TONE SRCE** menu selection.

(t) Press the Rotary Knob to bring up the **HR TONE SRCE** Menu.

(u) Turn the Rotary Knob to highlight the **QRS** menu selection.

(v) Press the Rotary Knob to select **QRS**.

(w) Press the **NORMAL SCREEN** Control Key.

(4) Verify the following:

(a) Trace B shows a waveform train of moving QRS pulses without jittering.

(b) Trace B numerics indicate an ECG count of 60 ±1 BPM.

(c) The QRS Symbol (flashing heart) is present.

(d) QRS Heart Rate Tone is present with NO double tones.

(5) Set the Patient Simulator to output a 2 mV QRS pulse at 60 BPMs.

(6) Verify the following:

(a) Trace B shows a waveform train of moving QRS pulses without jittering.

(b) Trace B numerics indicate an ECG count of 60 ±1 BPMs.

(c) The QRS Symbol (flashing heart) is present.

(d) QRS Heart Rate Tone is present with NO double tones.

(7) Set the Patient Simulator to output a 2 mV QRS pulse at 120 BPMs.

(8) Verify the following:

(a) Trace B shows a waveform train of moving QRS pulses without jittering.

(b) Trace B numerics indicate an ECG count of 120 ±1 BPM.

(c) The QRS Symbol (flashing heart) is present.

(d) QRS Heart Rate Tone is present with NO double tones.

(9) Set the Patient Simulator to output a 2 mV QRS pulse at 240 BPMs.

(10) Verify the following:

(a) Trace B shows a waveform train of moving QRS pulses without jittering.

(b) Trace B numerics indicate an ECG count of 240 ±5 BPMs.

(c) The QRS Symbol (flashing heart) is present.

(d) QRS Heart Rate Tone is present with NO double tones.

(11) Set the Patient Simulator to output a 2 mV QRS pulse at 300 BPMs.

(12) Verify lead **II** alternately flashes "**250**" and "**OVR**."

(13) Turn the Rotary Knob to highlight the ECG Icon.

(14) Press the Rotary Knob to bring up the **ECG** Menu.

(15) Turn the Rotary Knob to highlight the **CALIBRATE** menu selection.

(16) Press the Rotary Knob to select **ECG**.

(17) Verify a calibration waveform on Trace B.

(18) Press the Rotary Knob to select **OFF**.

(19) Confirm lead **II** is selected for **TRACE B LEAD**.

(20) Set Patient Simulator to output a 1 mV square wave at 2 Hz (240 BPM).

(21) Verify an ECG count of 240 ±5 BPM.

(22) Set the Patient Simulator to output a 1.5 mV QRS pulse at 60 BPM'S.

(23) Disconnect the Patient Simulator from the ECG transmitter.

aa. **ECG Lead Fail Verification (Trace B).** (If the Dual ECG option is installed) Perform the following procedure to verify proper operation of the ECG Lead Fail Circuitry:

(1) Connect an ECG Patient Simulator to the WECG transmitter leads (see Page 5-13, Table 5-1).

(2) Set the Patient Simulator to output a 1.5 mV QRS pulse at 60 BPM'S (NORMAL SINUS mode).

(3) Select ECG lead **I** for **TRACE B LEAD**.

(4) If “NEO” is displayed above the ECG icon on the DCU display, change the Patient Mode to Adult as follows:

(a) Press the **SETUP** Control Key.

(b) Turn the Rotary Knob to highlight the **PATIENT** menu selection.

(c) Press the Rotary Knob to select **PATIENT**.

(d) Turn the Rotary Knob to highlight the **ADULT** menu selection.

(e) Press the Rotary Knob to select **ADULT**.

(f) Press the **NORMAL SCREEN** Control Key.

(5) Remove one wire at a time (that pertains to the selected lead) until all the lead wires have been tested (see Page 5-13, Table 5-1). In each case verify that **within 25 seconds** of removal of each wire that the "**LEAD FAIL**" message appears to the right of the selected lead at the top left of the display screen and that there is no QRS Tone or Number displayed. Verify that the trace recovery time is within 25 seconds of Lead Fail Correction.

(6) Select each lead in order and perform substep "5" until all the leads have been verified. Refer to Page 5-16, Table 5-2 for correct ECG Trace A/B Lead and ECG Patient Simulator Terminal selections.

(7) Disconnect the Patient Simulator from the WECG transmitter.

ab. **ECG Neonate Sensitivity Verification (Trace B).** (If the Dual ECG option is installed) Perform the following procedure to verify proper operation of the ECG Neonatal Circuitry:

(1) Connect an ECG Patient Simulator to the WECG transmitter leads (see Page 5-13, Table 5-1).

(2) Set the Patient Simulator to output a 0.15 mV QRS pulse at 80 BPMs.

(3) Select ECG Lead III as follows:

(a) Turn the Rotary Knob to highlight the ECG Icon.

(b) Press the Rotary Knob to bring up the **ECG** Menu.

(c) Turn the Rotary Knob to highlight the **TRACE B LEAD** menu selection.

(d) Press the Rotary Knob to select **TRACE B LEAD**.

(e) Turn the Rotary Knob to highlight the **III** menu selection.

(f) Press the Rotary Knob to select lead **III**.

(g) Press the **NORMAL SCREEN** Control Key.

(4) Verify that, while still in Adult Mode, there is no QRS Tone and 0 BPM is displayed.

(5) Change the Patient Mode as follows:

(a) Press the **SETUP** Control Key.

(b) Turn the Rotary Knob to highlight the **PATIENT** menu selection.

(c) Press the Rotary Knob to select **PATIENT**.

(d) Turn the Rotary Knob to highlight the **NEO** menu selection.

(e) Press the Rotary Knob to select **NEO**.

(f) Press the **NORMAL SCREEN** Control Key.

(6) Verify a QRS count of "80," ±1 a flashing heart symbol and audible tone, and no **LEAD FAIL** message in the ECG message area.

(7) Set the Patient Simulator to output a 1.0 mV QRS pulse at 60 BPMs.

(8) Change the Patient Mode as follows:

(a) Press the **SETUP** Control Key.

(b) Turn the Rotary Knob to highlight the **PATIENT** menu selection.

(c) Press the Rotary Knob to select **PATIENT**.

(d) Turn the Rotary Knob to highlight the **ADULT** menu selection.

(e) Press the Rotary Knob to select **ADULT**.

(f) Press the **NORMAL SCREEN** Control Key.

(9) Select ECG Lead II as follows:

(a) Turn the Rotary Knob to highlight the ECG Icon.

(b) Press the Rotary Knob to bring up the **ECG** Menu.

(c) Turn the Rotary Knob to highlight the **TRACE B LEAD** menu selection.

(d) Press the Rotary Knob to select **TRACE B LEAD**.

(e) Turn the Rotary Knob to highlight the **II** menu selection.

(f) Press the Rotary Knob to select lead **II**.

(g) Press the **NORMAL SCREEN** Control Key.

(10) Disconnect the Patient Simulator and ECG transmitter.

5.6.3 Respiration Verification. (If the Respiration option is installed) Perform the following to verify proper operation of the Respiration system:

a. Connect a Respiration Pillow Sensor to the RESP input on the WSPO2 Transmitter Module.

b. Using the system clock in the upper left-hand corner of the DCU display, repeatedly compress the pillow sensor approximately every two (2) seconds to simulate a breathing pattern.

c. Verify a flashing lung, and an approximate respiration rate of 30 (lower value on the EtCO2 icon) are displayed on the DCU.

d. Using the system clock in the upper left-hand corner of the DCU display, repeatedly compress the pillow sensor approximately twice every second to simulate a breathing pattern.

e. Verify a flashing lung, and an approximate respiration rate of 120 (lower value on the EtCO2 icon) are displayed on the DCU.

f. Disconnect the pillow sensor from the transmitter.

5.6.4 NIBP Verification. Perform the following to verify proper operation of the NIBP system:

a. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).

b. Type: nav.

c. Setup the NIBP as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(3) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(4) Press the <Down Arrow> key until the **NIBP TESTS** menu selection is highlighted.

(5) Press the <Enter> key to select **NIBP TESTS**.

(6) Press the <Down Arrow> key until the **CALIBRATE** menu selection is highlighted.

(7) Press the <Enter> key to display the NIBP Cal Screen (see Section 3: Figure 3-16).

d. **NIBP Calibration Test.** Verify the following for both Primary (Sense) and Secondary (Inflate) Transducers:

(1) **PRI**(mary):

(a) OFFSET PRESS = 9 (±5).

(b) PRESS READING = 0 (±1).

(2) **SEC**(ondary):

(a) OFFSET PRESS = 10 (±5).

(b) PRESS READING = 0 (±1).

e. Connect Pressure Tester (Deadweight or Manometer) to the NIBP Sense Port (located beneath the SPO2 connector on the PCU).

f. **Primary Transducer Range and Accuracy Test.** Perform the Primary Pressure Transducer Range and Accuracy Test as follows:

(1) Set the Pressure Tester for 200 mmHg.

(2) Verify the following:

(a) OFFSET PRESS = 209 (±2).

(b) PRESS READING = 200 (±2).

(3) Set the Pressure Tester for 150 mmHg.
(4) Verify the following:
  (a) OFFSET PRESS = 159 (±2).
  (b) PRESS READING = 150 (±2).
(5) Set the Pressure Tester for 100 mmHg.
(6) Verify the following:
  (a) OFFSET PRESS = 109 (±1).
  (b) PRESS READING = 100 (±1).
(7) Set the Pressure Tester for 50 mmHg.
(8) Verify the following:
  (a) OFFSET PRESS = 59 (±1).
  (b) PRESS READING = 50 (±1).
(9) Set the Pressure Tester for 0 mmHg.
(10) Verify the following:
  (a) OFFSET PRESS = 9 (±5).
  (b) PRESS READING = 0 (±1).
(11) Set the Pressure Tester for 50 mmHg.
(12) Verify the following:
  (a) OFFSET PRESS = 59 (±1).
  (b) PRESS READING = 50 (±1).
(13) Set the Pressure Tester for 100 mmHg.
(14) Verify the following:
  (a) OFFSET PRESS = 109 (±1).
  (b) PRESS READING = 100 (±1).
(15) Set the Pressure Tester for 150 mmHg.
(16) Verify the following:
  (a) OFFSET PRESS = 159 (±2).
  (b) PRESS READING = 150 (±2).
(17) Set the Pressure Tester for 200 mmHg.
(18) Verify the following:
  (a) OFFSET PRESS = 209 (±2).
  (b) PRESS READING = 200 (±2).
(19) Set the Pressure Tester for 284 mmHg.
(20) Verify maximum pressure as follows:
  (a) OFFSET PRESS = 293 (±2).
  (b) PRESS READING = 284 (±2).
(21) Release the pressure and disconnect the Pressure Tester from the Sense Port.
(22) Press the <Esc> key to display the Normal Screen.

g. Reset the dump valve by repeating step "c" above.

h. Connect Pressure Tester (Deadweight or Manometer) to the NIBP Inflate Port (located beneath the ECG connector on the PCU).

i. **Secondary Transducer Range and Accuracy Test.** Perform the Secondary Pressure Transducer Range and Accuracy Test as follows:

(1) Set the Pressure Tester for 200 mmHg.

(2) Verify the following:

(a) OFFSET PRESS = 210 (±2).

(b) PRESS READING = 200 (±2).

(3) Set the Pressure Tester for 150 mmHg.

(4) Verify the following:

(a) OFFSET PRESS = 160 (±2).

(b) PRESS READING = 150 (±2).

(5) Set the Pressure Tester for 100 mmHg.

(6) Verify the following:

(a) OFFSET PRESS = 110 (±1).

(b) PRESS READING = 100 (±1).

(7) Set the Pressure Tester for 50 mmHg.

(8) Verify the following:

(a) OFFSET PRESS = 60 (±1).

(b) PRESS READING = 50 (±1).

(9) Set the Pressure Tester for 0 mmHg.

(10) Verify the following:

(a) OFFSET PRESS = 10 (±5).

(b) PRESS READING = 0 (±1).

(11) Set the Pressure Tester for 50 mmHg.

(12) Verify the following:

(a) OFFSET PRESS = 60 (±1).

(b) PRESS READING = 50 (±1).

(13) Set the Pressure Tester for 100 mmHg.

(14) Verify the following:

(a) OFFSET PRESS = 110 (±1).

(b) PRESS READING = 100 (±1).

(15) Set the Pressure Tester for 150 mmHg.

(16) Verify the following:

(a) OFFSET PRESS = 160 (±2).

(b) PRESS READING = 150 (±2).

(17) Set the Pressure Tester for 200 mmHg.

(18) Verify the following:

(a) OFFSET PRESS = 210 (±2).

(b) PRESS READING = 200 (±2).

(19) Set the Pressure Tester for 294 mmHg.

(20) Verify maximum pressure as follows:

(a) OFFSET PRESS = 304 (±2).

(b) PRESS READING = 294 (±2).

(21) Release the pressure and disconnect the Pressure Tester from the Inflate Port.

(22) Press the <Esc> key to display the Normal Screen.

j. **Secondary Transducer Over Pressure Test.** Perform Secondary Pressure Transducer Over Pressure Verification as follows:

(23) Connect a manometer to the NIBP Inflate port (located beneath the ECG connector on the PCU).

(24) If the patient selection is NEO (located over the ECG Icon), perform the following to select ADULT:

(a) Press the <F4> key.

(b) Press the <Down Arrow> key until the **PATIENT** menu selection is highlighted.

(c) Press the <Enter> key to select **PATIENT**.

(d) Press the <Down Arrow> key until the **ADULT** menu selection is highlighted.

(e) Press the <Enter> key to select **ADULT**.

(f) Press the <Esc> key to display the Normal Screen.

(1) Setup the NIBP as follows:

(g) Press the <F4> key.

(h) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(i) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(j) Press the <Down Arrow> key until the **NIBP TESTS** menu selection is highlighted.

(k) Press the <Enter> key to select **NIBP TESTS**.

(l) Press the <Down Arrow> key until the **CALIBRATE** menu selection is highlighted.

(m) Press the <Enter> key to make the selection.

(2) Close the bleed screw on the manometer hand bulb. Set the Pressure Tester for 295 mmHg (±14).

(3) Verify that when the above limits are violated, the pressure readings fall in the **CALIBRATE** menu and an "OVR-PRES" warning message is displayed in the lower left hand corner of the screen.

(4) Disconnect the manometer from the NIBP Inflate port.

(5) Press the <Esc> key to display the Normal Screen.

k. **Primary Transducer Over Pressure Test.** Perform Primary Pressure Transducer Over Pressure Verification as follows:

(1) Connect a manometer to the NIBP Sense port (located beneath the SPO2 connector on the PCU).

(2) Setup the NIBP as follows:

(n) Press the <F4> key.

(o) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(p) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(q) Press the <Down Arrow> key until the **NIBP TESTS** menu selection is highlighted.

(r) Press the <Enter> key to select **NIBP TESTS**.

(s) Press the <Down Arrow> key until the **CALIBRATE** menu selection is highlighted.

(t) Press the <Enter> key to make the selection.

(3) Close the bleed screw on the manometer hand bulb. Set the Pressure Tester for 285 mmHg (±14).

(4) Verify that when the above limits are violated, an "OVR-PRES" warning message is displayed in the lower left corner of the screen.

(5) Disconnect the manometer from the NIBP Sense port.

(6) Press the <Esc> key to display the Normal Screen.

l. **Leak Time-Out Test.** Perform Leak Time-Out Verification as follows:

(1) With nothing connected to the NIBP Ports on the monitor front panel, press the <F7> key to start up the pump.

(2) Verify that the pump shuts off after 6 seconds ±1.5 seconds and that the error message “NOT INFLATING” is displayed in the lower left corner of the screen.

m. **Calibration Error Test.** Perform Calibrate Error Verification as follows:

(1) Connect the Manometer to the NIBP Sense Port (located beneath the SPO2 connector on the PCU).

(2) Inflate the Manometer to 15 mmHg.

(3) Press the <F7> key to start up the pump.

(4) Verify that the pump does not start up.

(5) After 10 seconds, release pressure from the manometer and verify that the pump starts up.

n. **Pneumatic Leak Test.** Perform the Pneumatic Leak Test as follows:

(1) Connect a 40 foot leak hose to the NIBP Ports on the PCU.

(2) Press the <F4> key.

(3) Press the <Down Arrow> key until the **SERVICE (BIO-MED**) menu selection is highlighted.

(4) Press the <Enter> key to select **SERVICE (BIO-MED**).

(5) Press the <Down Arrow> key until the **NIBP TESTS** menu selection is highlighted.

(6) Press the <Enter> key to select **NIBP TESTS**.

(7) Press the <Down Arrow> key until the **LEAK TEST** menu selection is highlighted.

(8) Press the <Enter> key to select **LEAK TEST**.

NOTE

The pump will start automatically and cycle approximately every 30 seconds. A difference of greater than 10 between the "PEAK" and "FINAL" is considered a failure and will register in the "failed" window.

(9) Verify a minimum of 2 Leak Test Cycles with no failures.

(10) Disconnect the leak hose.

(11) Press the <Esc> key to display the Normal Screen.

o. **Normal Blood Pressure Test.** Perform Normal Blood Pressure Reading Verification as follows:

NOTE

Perform the substeps below using an NIBP Analyzer if available.

(1) Perform Adult Verification as follows:

(a) Connect an Adult Cuff (Invivo Part Number 9010M) to the NIBP Ports on the PCU.

(b) Place the Adult Cuff on arm.

(2) If the patient selection is NEO (located over the ECG Icon), perform the following to select ADULT:

(a) Press the <F4> key.

(b) Press the <Down Arrow> key until the **PATIENT** menu selection is highlighted.

(c) Press the <Enter> key to select **PATIENT**.

(d) Press the <Down Arrow> key until the **ADULT** menu selection is highlighted.

(e) Press the <Enter> key to select **ADULT**.

(f) Press the <Esc> key to display the Normal Screen.

(3) Press the <F7> key to start up the pump.

(4) Verify that the Cuff inflates to 170 mmHg before the pump stops and the system begins to release pressure through the bleed valves.

(5) When the blood pressure determination is complete, verify that the Cuff deflates and Systolic, Mean and Diastolic Blood Pressure numerics are present in the lower left of the screen (in the NIBP Icon).

(6) Remove the Cuff from the arm.

(7) Attach Cuff to a solid object (approximately arm size), press the <F7> key and verify a NIBP determination of 0 for Systolic, Mean and Diastolic.

(8) Disconnect the Cuff from the NIBP Ports on the monitor front panel.

NOTE

Perform the substeps below using an NIBP Analyzer if available.

(9) Perform Neonatal Verification as follows:

(a) Connect a Neonatal Cuff (Invivo Part Number AN01A or AN02A) to your finger.

(b) Connect the Neonatal Cuff to the NIBP Ports on the PCU.

(10) If the patient selection is ADULT (located over the ECG Icon), perform the following to select NEO:

(a) Press the <F4> key.

(b) Press the <Down Arrow> key until the **PATIENT** menu selection is highlighted.

(c) Press the <Enter> key to select **PATIENT**.

(d) Press the <Down Arrow> key until the **NEO** menu selection is highlighted.

(e) Press the <Enter> key to select **NEO**.

(f) Press the **<**Esc> key to display the Normal Screen.

(11) Hold hand with cuffed finger above shoulder height (to ensure blood pressure reading below 100 mmHg) and press the **<**F7> key to start up the pump.

(12) Verify that the Cuff inflates to 120 mmHg before the pump stops and the system begins to release pressure through the bleed valves.

(13) When the blood pressure determination is complete, verify that the Cuff deflates and Systolic, Mean and Diastolic Blood Pressure numerics are present in the lower left of the screen (in the NIBP Icon).

(14) Remove the Cuff from the finger.

(15) Attach Cuff to a solid object (approximately finger size), press the **<**F7> key and verify a NIBP determination of 0 for Systolic, Mean and Diastolic.

(16) Disconnect the Cuff from the NIBP Ports on the PCU.

(17) Return patient selection to the Adult mode as follows:

(a) Press the <F4> key.

(b) Press the <Down Arrow> key until the **PATIENT** menu selection is highlighted.

(c) Press the <Enter> key to select **PATIENT**.

(d) Press the <Down Arrow> key until the **ADULT** menu selection is highlighted.

(e) Press the <Enter> key to select **ADULT**.

(f) Press the **<**Esc> key to display the Normal Screen.

p. If an NIBP Analyzer is available, perform the NIBP Range and Accuracy Verification as follows:

(1) Adult Range and Accuracy Verification:

Systolic	Diastolic	Mean	Tolerance
45	15	(25)	±5mmHg
80	50	(62)	±5mmHg
120	80	(90)	±10mmHg
150	100	(115)	±10mmHg
245	185	(205)	±10mmHg

(2) Neonatal Range and Accuracy Verification:

Systolic	Diastolic	Mean	Tolerance
45	15	(25)	±5mmHg
80	50	(62)	±5mmHg
120	80	(90)	±10mmHg
150	100	(115)	±10mmHg
190	140	(155)	±10mmHg

NOTE

The uncertainty specifications of the NIBP Analyzer must be added to the 3160 tolerances for proper accuracy verification.

NOTE

Perform the SPO2 Verification with an SPO2 Simulator if available.

5.6.5 SPO2 Verification. Perform the following to verify proper operation of the standard Wireless, or alternate fiber optic (F.O.), SPO2 system:

a. Insert a fully charged battery pack into the WSPO2 transmitter.

b. Place your finger into the probe and, after the monitor waveform display levels out, verify the following:

(1) SPO2 Pulse occurs with the operator's heart count.

(2) The SPO2% is within reasonable limits for the operator (90 to 100).

(3) The SPO2 waveform is smooth with no steps.

c. Remove the probe from your finger.

d. If an SPO2 Simulator is available, verify the accuracy of Oxygen Saturation Value with Invivo probes as follows:

Oxygen Saturation	Tolerance
90-100%	±2
80-90%	±2.2
70-80%	±2.5
60-70%	±3

NOTE

The uncertainty specifications of the SPO2 Simulator must be added to the 3160 tolerances for proper accuracy verification.

NOTE

Either the EtCO2 Bench or the Agent Bench can be installed as *mutually exclusive* options in a particular monitor. Ensure that the correct procedure (Page 5-29, paragraph 5.6.6 or Page 5-34, paragraph 5.6.8) is performed, depending on the option installed in the monitor to be verified.

5.6.6 EtCO2 Verification. (If EtCO2 Option is installed) Perform the following to verify proper operation of the EtCO2 system:

a. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).

b. Type: nav.

c. Turn on the EtCO2 and Agents icons as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **PARAMETER SELECTION** menu selection is highlighted.

(3) Press the <Enter> key to select **PARAMETER SELECTION**.

(4) Press the <Down Arrow> key until the **EtCO2** menu selection is highlighted.

(5) Press the <Enter> key to select **EtCO2**.

(6) Press the <Down Arrow> key until the **ON** menu option is highlighted.

(7) Press the <Enter> key to select **ON**.

(8) Press the **<**Esc> key to display the Normal Screen.

d. Allow the EtCO2 Bench to warm up for approximately 25 minutes.

e. **CO2 Occlusion Test.** Perform the CO2 Occlusion Test as follows:

(1) Place your finger over the GAS (EtCO2) port on the water trap and verify the following:

(a) The message "CO2 OCCLUSION" appears at the top of the display screen.

(b) The pump motor speed increases in an attempt to clear the occlusion.

(2) Remove your finger from the GAS (EtCO2) port and verify the following:

(a) The pump motor speed decreases when it senses the occlusion is cleared.

(b) The message "READJUSTING CO2 ZERO" appears at the top of the display screen.

f. **Pump Air Flow Test.** Perform Pump Air Flow Test as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(3) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(4) Press the <Down Arrow> key until the **GAS CAL** menu selection is highlighted.

(5) Press the <Enter> key to select **GAS CAL**.

(6) Press the <Down Arrow> key until the **ZERO CAL** menu selection is highlighted.

(7) Press the <Enter> key to select **ZERO CAL**.

(8) Place your finger over the EtCO2 Zero Port on the bottom panel of the PCU and verify a definite change in the speed of the pump motor.

(9) Remove your finger from the EtCO2 Zero Port.

(10) Place your finger over the EtCO2 Waste Gas Port on the WPU rear panel and verify a definite change in the speed of the pump motor.

(11) Remove your finger from the EtCO2 Waste Gas Port.

(12) Connect Flow Meter to the GAS (EtCO2) port on the water trap and verify an air flow of 80 ml (±16 ml).

(13) Disconnect the Flow Meter.

g. **Span Calibration Test.** Perform the Span Calibration Test as follows:

(1) Connect the aerosol CAL GAS can (Invivo Part Number 9010F) to the GAS (EtCO2) port on the water trap.

(2) Simulate a breathing pattern (by pressing and releasing the nozzle of the can) and verify the following:

(a) EtCO2 = 76 (±3) mmHg.*

(b) A waveform appears in the EtCO2 Trace area.

NOTE

*This CO2 reading varies according to altitude. The above reading indicates the expected CO2 value to be observed when conducting this test on a monitor located at sea level (or 0 altitude). (See Appendix F for a barometric pressure graph.)

(3) Disconnect the Calibration Gas can from the monitor.

5.6.7 Agents Verification (with EtCO2). (If Anesthetic Agents Option is installed) Perform the following to verify proper operation of the EtCO2 and Agents systems:

a. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).

b. Type: nav.

c. Turn on the EtCO2 and Agents icons as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **PARAMETER SELECTION** menu selection is highlighted.

(3) Press the <Enter> key to select **PARAMETER SELECTION**.

(4) Press the <Down Arrow> key until the **AGENTS** menu selection is highlighted.

(5) Press the <Enter> key to select **AGENTS**.

(6) Press the <Down Arrow> key until the **ON** menu option is highlighted.

(7) Press the <Enter> key to display the Normal Screen.

(8) Press the <Esc> key to display the Normal Screen.

d. Allow the Agent Bench to warm up for approximately 25 minutes.

e. **CO2 Occlusion Test.** Perform the CO2 Occlusion Test as follows:

(1) Place your finger over the GAS (EtCO2) port on the water trap and verify the following:

(a) The message “CO2 OCCLUSION” appears at the top of the display screen.

(b) The pump motor speed increases in an attempt to clear the occlusion.

(2) Remove your finger from the GAS (EtCO2) port and verify the following:

(a) The pump motor speed decreases when it senses the occlusion is cleared.

(b) The message "READJUSTING CO2 ZERO" appears at the top of the display screen.

f. **Pump Air Flow Test.** Perform the Pump Air Flow Test as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(3) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(4) Press the <Down Arrow> key until the **GAS CAL** menu selection is highlighted.

(5) Press the <Enter> key to select **GAS CAL**.

(6) Press the <Down Arrow> key until the **ZERO CAL** menu selection is highlighted.

(7) Press the <Enter> key to select **ZERO CAL**.

(8) Place your finger over the EtCO2 Zero Port on the bottom panel of the PCU and verify a definite change in the speed of the pump motor.

(9) Remove your finger from the EtCO2 Zero Port.

(10) Place your finger over the EtCO2 Waste Gas Port on the WPU rear panel and verify a definite change in the speed of the pump motor.

(11) Remove your finger from the EtCO2 Waste Gas Port.

(12) Connect Flow Meter to the GAS (EtCO2) port on the water trap and verify an air flow of 230 ml (±40 ml).

(13) Disconnect the Flow Meter.

g. **Pump Speed Test.** Perform the Pump Speed Test as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(3) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(4) Press the <Down Arrow> key until the **GAS CAL** menu selection is highlighted.

(5) Press the <Enter> key to select **GAS CAL**.

(6) Press the <Down Arrow> key until the **SPAN CAL** menu selection is highlighted.

(7) Press the <Enter> key to select **SPAN CAL**.

(8) In the **ENTER PASSWORD**: menu, select service code **40727**.

(9) Press the <Enter> key to enter the code and display the Agents **SPAN CAL** menu (see Section 3: Figure 3-20).

(10) Wait two (2) minutes for zero calibration.

(11) Press the <Down Arrow> key until the **PUMP SPEED** menu selection is highlighted.

(12) Press the <Enter> key to select **PUMP SPEED**.

(13) Press the <Down Arrow> key to vary the pump speed between the 01 (lowest) and 07 (highest) settings. Confirm that the pump speed is lowest at the minimum 01 setting, and increases incrementally as the setting is adjusted up to a maximum value of 07 on the display.

(14) Press the <Down Arrow> key until a pump speed of 03 (default) is displayed in the entry box, then press the <Enter> key to select that value.

(15) Press the <Esc> key to display the Normal Screen.

h. **Gas Monitor Test.** Perform the Gas Monitor Test as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(3) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(4) Press the <Down Arrow> key until the **GAS CAL** menu selection is highlighted.

(5) Press the <Enter> key to select **GAS CAL**.

(6) Press the <Down Arrow> key until the **GAS MONITOR** menu selection is highlighted.

(7) Press the <Enter> key to select **GAS MONITOR**.

(8) Verify the following numeric values in the Gas Monitor Screen (see Section 3: Figure 3-22):

Description	**Displayed Value**
CO2	1.0000 ±0.02
N2O	1.0000 ±0.02
DES	1.0000 ±0.02
ISO	1.0000 ±0.02
HAL	1.0000 ±0.02
ENF	1.0000 ±0.02
SEV	1.0000 ±0.02
SEN TMP	52.0000 ±6
BD TMP	52.0000 ±6
CO2 CORR.	1.0 ±0.5
STATUS*	0

NOTE

*The above "STATUS" code is used as a diagnostics tool for identifying and correcting malfunctions related to the agent bench. The following codes apply:

0 = No failure.
1 = The blocked channel does not detect heat.
2 = Sensor voltage out of range.
3 = Invalid thermal gains.
4 = EEPROM failure.
5 = Cannot distinguish between DES and SEV.
6 = EEPROM agent type not supported.
7 = EEPROM checksum test failed.
8 = EEPROM root solution failed.
9 = EEPROM interference matrix inversion failed.
10 = EEPROM version different than 3.
11 = EEPROM version not supported.
12 = EEPROM chip test failed.
13 = Agent bench not present.

(9) Press the <Enter> key to clear the Gas Monitor Calibration box from the screen.

(10) In the **GAS CAL** menu, press the <Down Arrow> key to highlight the **RETURN** menu selection.

(11) Press the <Enter> key to select **RETURN**.

i. **Span Calibration Test.** Perform the Span Calibration Test as follows:

(1) Disconnect the sample tubing from the GAS (EtCO2) port on the water trap.

(2) Leave the port open for a minimum of 90 seconds to vent all residual gases from the water trap.

(3) Attach the T-fitting on the "QC CHECK GAS" can corresponding to the agent to be verified (see below for a list of available aerosol gas cans) to the GAS (EtCO2) port on the water trap.

	Invivo	Gas Mixture				
Agent	**Gas Can P/N**	**%Agent**	**%O2**	**%CO2**	**%N2O**	**%N2**
Desflurane	9034A	7.0	21.0	5.0	60.0	7.0
Enflurane	9034B	1.0	21.0	5.0	60.0	13.0
Sevoflurane	9034C	1.5	21.0	5.0	60.0	12.5
Isoflurane	9034D	1.0	21.0	5.0	60.0	13.0
Halothane	9034E	1.0	21.0	5.0	60.0	13.0

(4) Apply the selected agent to the GAS port for a minimum of 30 seconds.

(5) Verify the reading below applicable to the agent currently being verified. (Readings are displayed in the **AGENT** icon.):

Agent	**Agent ID**	**Reading***
Desflurane	DES	7.0% ±1.0
Enflurane	ENF	1.0% ±0.27
Sevoflurane	SEV	1.5% ±0.33
Isoflurane	ISO	1.0% ±0.27
Halothane	HAL	1.0% ±0.27

NOTE

*Verification in service test tolerances has been tightened to ensure end user specifications.

(6) Verify the readings for each of the remaining gases listed below. (Readings are displayed at the indicated screen locations.):

Gas	Gas ID	Reading	Location
Oxygen	O2	21% ±1	AGENT icon
Carbon Dioxide	CO2	(5% ±0.6)*	EtCO2 icon (upper value)
Nitrous Oxide	N2O	60% ±8	EtCO2 trace (lower value)

(7) Disconnect the gas can from the water trap and repeat steps "2" through "6" above for each agent to be verified.

NOTE

*This CO2 reading is expressed in units of mmHg (not %) on the display and varies according to altitude. The following mathematical equation can be used to calculate barometric pressure as a function of altitude (p(h)):

$$\mathbf{p(h) = 4.088 \times 10^{-12}(518.7 - 0.00356h)^{5.256}}$$

Where:

p = Barometric Pressure (in mmHg)

h = Altitude (in feet)

Substituting for known value $h = 0$ in the above formula to solve for function p(h) at sea level, $p(h) = 4.088 \times 10^{-12}[(518.7 - 0.00356(0)]^{5.256} = 4.088 \times 10^{-12}(518.7)^{5.256} =$ 760 mmHg.

1% CO2 at sea level would then be given by the expression:

$$\mathbf{1\%\ p(h) = 1/100 \times p(h) = p(h)/100}$$

Substituting for the known value of p(h) = 760, p(h)/100 = 760/100 = 7.6 mmHg. A monitor located at sea level should therefore display a 5% CO2 reading of:

$$\mathbf{5\%\ CO2 = 5 \times p(h)/100 = 5/100 \times p(h) = p(h)/20}$$

Again substituting known value 760 for variable p(h) above, p(h)/20 = 760/20 = 38 mmHg.

Substituting the calculated value of 38 for 5% CO2 in the formula below yields a maximum tolerance of 5% CO2 x 0.12 = 38 x 0.12 = approximately ("~") ±5 mmHg (rounded up from the calculated value of 4.56 mmHg).

Maximum Tolerance = 5% CO2 x 12% accuracy = 5% CO2 x 12/100 = 5% CO2 x 0.12

Applying the same formulas presented in **bold** print above, a monitor located at an altitude of 1,000 feet (h = 1,000) for example, should display a 5% CO2 reading of ~37 ± 4 mmHg. (See Appendix F for a barometric pressure graph.)

5.6.8 Fiber Optic Temperature Verification. (If the F.O. Temperature option is installed) Perform the following to verify proper operation of the Temperature system:

a. On the DCU, setup up the Temperature system as follows:

(1) Press the **SETUP** Control Key.

(2) Turn the Rotary Knob to highlight the **PARAMETER SELECTION** menu selection.

(3) Press the Rotary Knob to select **PARAMETER SELECTION**.

(4) Turn the Rotary Knob to highlight the **TEMP** menu selection.

(5) Press the Rotary Knob to select **TEMP**.

(6) Turn the Rotary Knob to highlight the **TEMP ON** parameter selection.

(7) Press the Rotary Knob to select **TEMP ON**.

(8) Press the **NORMAL SCREEN** Control Key.

(9) Turn the Rotary Knob to highlight the **TEMP** parameter icon.

(10) Press the Rotary Knob to select **TEMP**.

(11) Turn the Rotary Knob to highlight the **UNIT** parameter selection.

(12) Press the Rotary Knob to select **UNIT**.

(13) Turn the Rotary Knob to highlight the **°C** parameter selection.

(14) Press the Rotary Knob to select **°C**.

(15) Press the **NORMAL SCREEN** Control Key.

b. Connect the following fully calibrated Fiber Optic temperature reference probes one at a time to the TEMP Port on the PCU and verify for each separate reading that the displayed numeric value is within a maximum tolerance of ±0.3 °C of the corresponding value marked on the probe:

(1) 21°C FISO probe.

(2) 37°C FISO probe.

(3) 43°C FISO probe.

c. Disconnect all FISO temperature reference probes from the PCU.

5.6.9 Monitor Calibration Verification. Perform Monitor Calibration Verification testing as follows:

a. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).

b. Type: nav.

c. Press the <F4> key.

d. Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

e. Press the <Enter> key to select **SERVICE (BIO-MED)**.

f. In the **SERVICE (BIO-MED)** menu, press the <Down Arrow> key to highlight the **MONITOR CAL** menu selection.

g. Press the <Enter> key to select **MONITOR CAL**.

h. Press the <Down Arrow> key to highlight the **YES** option.

i. Press the <Enter> key to display the Monitor Calibration Information Screen.

j. Press the <Down Arrow> key to display and verify the following numeric values in the Monitor Calibration Information Screen (see Section 3: Figure 3-24):

Description	**Displayed Value**
EtCO2 abs pres	8.15000 ±0.2
EtCO2 diff pres	2.30000 ±0.3
N2O	-7.25000 to -5.00000

Description	Displayed Value
AGENTS' ENF	-7.25000 to -5.00000
AGENTS' HALO	-7.95000 to -4.95000
AGENTS' BLOCKED	-8.00000 to -5.95000
AGENTS' DES	-6.50000 to -4.00000
AGENTS' GND 1	-9.09000 ±0.1
CO2 REF	-5.50000 to -1.50000
AGENTS' REF	-6.00000 to -4.00000
CO2	-6.00000 to -2.75000
AGENTS' ISO	-6.50000 to -5.00000
THERMISTOR	-7.70000 ±0.4
AGENTS' SEVO	-7.25000 to -4.75000
AGENTS' SOURCE	4.50000 to 6.00000
AGENTS' BD TEMP	-4.50000 ±0.6

k. Press the <Down Arrow> key to scroll to the end of the Monitor Calibration listings and highlight the **SHUT DOWN** menu selection.

l. Press the <Enter> key to select **SHUT DOWN**.

m. Verify that the screen blanks.

n. Set the PCU Power Switch to the OFF (⏻) position.

SECTION 6
ADJUSTMENT PROCEDURES

6.0 ADJUSTMENT PROCEDURES.

CAUTION

The **3160 Series Patient Monitors** contain Static Sensitive circuits. Proper handling procedures must be followed when touching any Printed Circuit Board (PCB) as static voltages usually present on clothing and personnel present great risk of damage to the circuits. **All Service Procedures *MUST* be performed by Properly Grounded Personnel at a Static-Free Work Station**.

6.1 Introduction. The recommended preventive maintenance intervals for the **3160** monitor are provided in Section 7 of this manual. However, any time repairs are made, options are installed or the monitor fails the Calibration and Verification Procedure, the monitor should be readjusted.

When power to the monitor is removed, a warm-up period of at least 25 minutes should elapse after power is reapplied to the unit, prior to performing any of the adjustment procedures provided in this section.

6.2 Required Test Equipment. Refer to Section 7: Page 7-1, paragraph 7.2 for a complete list of required test equipment.

6.3 DCU Adjustments. There are currently no recommended field adjustments for the AS240 DCU Display Assembly.

6.4 PCU Adjustments. There are currently no recommended field adjustments for the AS219 PCU Assembly.

6.5 WPU Adjustments. Field adjustments for the AS215 WPU Electronics Assembly are provided in the following paragraphs.

6.5.1 Setup. Perform the following to prepare the AS215 WPU Electronics Assembly for adjustment.

a. Ensure that the **3160** monitor is turned OFF, and the AS201 Power Adapter is disconnected.

b. Remove the 9064 backup batteries from the WPU base.

c. Perform Section 7: Page 7-13, paragraph 7.8.2(a) to remove the Display Assembly.

NOTE

Either the EtCO2 Bench or the Agent Bench can be installed as *mutually exclusive* options in a particular monitor. Ensure that the correct procedure (below) is performed, depending on the option installed in the monitor to be adjusted.

6.5.2 EtCO2 Adjustment Procedure. (If the EtCO2 Option is installed) Perform the following procedure to adjust the EtCO2 System.

a. Perform Page 6-1, paragraph 6.5.1 to setup the WPU.

b. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).

c. Reconnect the AS201 Power Adapter to the WPU and set the PCU Power Switch to the ON (⊙) position.

d. Type: nav.

e. Turn on the EtCO2 icon as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **PARAMETER SELECTION** menu selection is highlighted.

(3) Press the <Enter> key to select **PARAMETER SELECTION**.

(4) Press the <Down Arrow> key until the **EtCO2** menu selection is highlighted.

(5) Press the <Enter> key to select **EtCO2**.

(6) Press the <Down Arrow> key until the **ON** menu option is highlighted.

(7) Press the <Enter> key to select **ON**.

(8) Press the **<**Esc> key to display the Normal Screen.

f. Allow the EtCO2 to warm up for approximately 25 minutes.

g. **EtCO2 Span Calibration.** Perform EtCO2 Span Calibration as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(3) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(4) Press the <Down Arrow> key until the **GAS CAL** menu selection is highlighted.

(5) Press the <Enter> key to select **GAS CAL**.

(6) Press the <Down Arrow> key until the **SPAN CAL** menu selection is highlighted.

(7) Press the <Enter> key to select **SPAN CAL**.

(8) In the **ENTER PASSWORD:** menu, select service code **40727**.

(9) Press the <Enter> key to eneter the code and isplay the EtCO2 **SPAN CAL** menu (see Section 3: Figure 3-21).

(10) Connect the aerosol CAL GAS (Invivo P/N 9010F) to the GAS (EtCO2) port on the water trap.

(11) Apply the Calibration Gas to the GAS port by pressing the nozzle on the can.

(12) Allow the gas to flow for approximately 30 seconds until a stable reading is displayed on the monitor.

(13) Confirm the CO2 reading below. (Readings are displayed at the indicated screen location.):

Gas	Reading
	Location: EtCO2 icon
Carbon Dioxide*	← Upper Value

NOTE

*This reading is expressed in units of mmHg on the display and varies according to altitude. Since the concentration of CO2 gas in the Calibration Gas canister (Invivo Part Number 9010F) is 10%, and 1% CO2 equals 7.6 mmHg at sea level, a monitor located at that approximate elevation should display a 10% CO2 reading of 76 mmHg (10 x 7.6). 76 mmHg is based on a barometric pressure reading of 29.92 inches of mercury (Barometric pressure (Hg) x 25.4 mm/inch x 0.10). Since 1% CO2 equals 6.3 mmHg at 5,000 feet above sea level, a monitor located at that approximate elevation should display a CO2 reading of 63 mmHg (10 x 6.3).

If the above reading is incorrect on the monitor, perform the following steps:

(a) Press the <Down Arrow> key until the value displayed on the monitor matches the above "Reading." (This adjustment is performed in real time.)

(b) Press the <Enter> key to set the new **SPAN CAL** menu.

(c) Press the <Down Arrow> key to highlight the **STORE** menu selection.

(d) Press the <Enter> key to save the new setting.

(14) Disconnect the Calibration Gas from the monitor.

(15) Press the <Esc> key to display the Normal Screen.

h. Perform EtCO2 Verification (see Section 5: Page 5-29, paragraph 5.6.6).

6.5.3 Agents Adjustment Procedure. (If Anesthetic Agents Option is installed) Perform the following procedure to adjust the Agents System.

a. Perform Page 6-1, paragraph 6.5.1 to setup the WPU.

b. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).

c. Reconnect the AS201 Power Adapter to the WPU and set the PCU Power Switch to the ON (⊙) position.

d. Type: nav.

e. Turn on the EtCO2 and Agents icons as follows:

(1) Press the <F4> key.

(2) Press the <Down Arrow> key until the **PARAMETER SELECTION** menu is highlighted.

(3) Press the <Enter> key to select **PARAMETER SELECTION**.

(4) Press the <Down Arrow> key until the **AGENTS** menu selection is highlighted.

(5) Press the <Enter> key to select **AGENTS**.

(6) Press the <Down Arrow> key until the **ON** menu option is highlighted.

(7) Press the <Enter> key to select **ON**.

(8) Press the <Esc> key to display the Normal Screen.

f. Allow the Agent Bench to warm up for approximately 25 minutes.

g. **Agents Span Calibration.** Perform Agents Span Calibration as follows:

NOTE

The Agent Bench is span calibrated *one gas at a time* as indicated in the following steps.

(1) Disconnect the sample tubing from the GAS (EtCO2) port on the water trap.

(2) Leave the port open for a minimum of 90 seconds to vent all residual gases from the water trap.

(3) Press the <F4> key.

(4) Press the <Down Arrow> key until the **SERVICE (BIO-MED)** menu selection is highlighted.

(5) Press the <Enter> key to select **SERVICE (BIO-MED)**.

(6) Press the <Down Arrow> key until the **GAS CAL** menu selection is highlighted.

(7) Press the <Enter> key to select **GAS CAL**.

(8) Press the <Down Arrow> key until the **ZERO CAL** menu selection is highlighted.

(9) Press the <Enter> key to select **ZERO CAL**.

(10) Press the <Down Arrow> key until the **SPAN CAL** menu selection is highlighted.

(11) Press the <Enter> key to select **SPAN CAL**.

(12) In the **ENTER PASSWORD**: menu, select service code **40727**.

(13) Press the <Enter> key to enter the code and display the Agents SPAN CAL menu (see Section 3: Figure 3-20).

(14) Using the "SPAN CAL GAS" kit corresponding to the gas to be calibrated (see below for a list of available aerosol gas kits/cans), attach the femail Luer lock fitting on the stopcock assembly to the mating valve stem on the "SPAN CAL GAS" can.

Gas ID	Invivo Span Cal Gas Kit P/N*	Invivo Span Cal Gas Can P/N	Gas Mixture %Gas	Gas Mixture %N2
Carbon Dioxide	94006A	9091A	10.0	90.0
Nitrous Oxide	94006B	9091B	80.0	20.0
Desflurane	94006C	9091C	14.0	86.0
Sevoflurane	94006D	9091D	5.0	95.0
Isoflurane	94006E	9091E	5.0	95.0
Halothane	94006F	9091F	5.0	95.0

Gas ID	Invivo Span Cal Gas Kit P/N*	Invivo Span Cal Gas Can P/N	Gas Mixture %Gas	Gas Mixture %N2
Enflurane	94006G	9091G	5.0	95.0

NOTE

*Each Span Cal Gas Kit includes a Cal Gas canister, low pressure calibration reservoir assembly and instruction sheet. The "QC Check Gas" canisters (Invivo Part Numbers 9034A through 9034E) are provided for verification purposes only (see Section 5: Page 5-30, paragraph 5.6.7) and cannot be used for this procedure. Use only the gas kits/canisters listed above to perform span calibration on the Agent Bench.

(15) With the stopcock valve set to the Vertical OFF (VO) position (see Figure 6-1), connect the sample tubing to the GAS (EtCO2) port on the water trap.

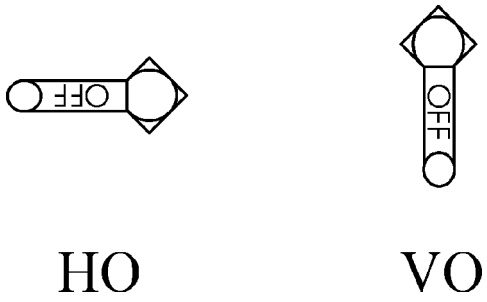


Figure 6-1. Stopcock Valve Positions

(16) Purge the low pressure calibration reservoir until the "CO2 Occlusion" message is displayed on the monitor.

(17) Quickly turn the stopcock valve to the Horizontal OFF (HO) position (see Figure 6-1), then disconnect the sample tubing from the water trap.

(18) Press down on the stopcock to begin filling the low pressure calibration reservoir.

CAUTION

Do not overfill the low pressure calibration reservoir.

(19) Release the stopcock, then reconnect the sample tubing to the water trap.

(20) Press the <Down Arrow> key to highlight the ID in the **SPAN CAL** menu applicable to the gas currently being calibrated.

(21) Press the <Enter> key to select the applicable Gas ID and value.

NOTE

Do not reset the selected value to its factory default setting of 1.000 before spanning.

(22) Apply the selected gas to the GAS port by turning the stopcock valve to the VO position. (The maximum number of times each aerosol canister may reliably be used to perform span calibration is indicated below.)

Gas ID	Invivo Gas Can P/N	Maximum No. Uses/Can*
Carbon Dioxide	9091A	50
Nitrous Oxide	9091B	50
Desflurane	9091C	7
Sevoflurane	9091D	2
Isoflurane	9091E	7
Halothane	9091F	8
Enflurane	9091G	3

NOTE

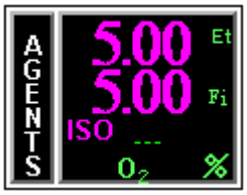
*Make a notation on the can label each time a gas can is used to calibrate the Agent Bench. Do not exceed the maximum number of uses indicated above per can.

(23) Allow the gas to flow for approximately 30 seconds until a stable reading is displayed on the monitor.

NOTE

If an anesthetic agent is being calibrated, perform step "24" below. To calibrate for CO2 or N2O, skip this step and proceed to step "25" instead.

(24) Agent Calibration. Confirm the reading below that is applicable to the agent currently being calibrated. (Readings are displayed in the **AGENTS** icon.):

Agent	Reading
Desflurane	
Sevoflurane	
Isoflurane	

Agent	Reading
Halothane	
Enflurane	

If the above reading is incorrect on the monitor, perform the following steps:

(a) Press the <Down Arrow> key until the value displayed on the monitor matches the above "Reading." (This adjustment is performed in real time.)

NOTE

The low pressure calibration reservoir must remain filled to a capacity of >10% total volume to ensure sufficient gas flow and concentration accuracy for span calibration.

(b) Press the <Enter> key to set the new SPAN CAL value.

(c) Press the <Down Arrow> key to highlight the **STORE** menu selection.

(d) Press the <Enter> key to save the new setting.

(25) CO2/N2O Calibration. Confirm the reading below that is applicable to the gas currently being calibrated. (Readings are displayed at the indicated screen locations.):

Gas	Reading
	Location: EtCO2 icon
Carbon Dioxide*	← Upper Value
	Location: EtCO2 trace
Nitrous Oxide	← Lower Value

NOTE

*This reading is expressed in units of mmHg on the display and varies according to altitude. Since the concentration of CO2 gas in the span cal gas canister (Invivo P/N 9091A) is 10% and 1% CO2 = 7.6 mmHg at sea level, a monitor located at that approximate elevation should display a 10% CO2 reading of 76 mmHg (10 x 7.6). 76 mmHg is based on a barometric pressure reading of 29.92 inches of mercury (Barometric pressure (Hg.) x 25.4 mm/inch x 0.10). Since 1% CO2 = 6.3 mmHg at 5,000 feet above sea level, a monitor located at that approximate elevation should display a CO2 reading of 63 mmHg (10 x 6.3).

If the above reading is incorrect on the monitor, perform the following steps:

(a) Press the <Down Arrow> key until the value displayed on the monitor matches the above "Reading." (This adjustment is performed in real time.)

NOTE

The low pressure calibration reservoir must remain filled to a capacity of >10% total volume to ensure sufficient gas flow and concentration accuracy.

(b) Press the <Enter> key to set the new SPAN CAL value.

(c) Press the <Down Arrow> key to highlight the **STORE** menu selection.

(d) Press the <Enter> key to save the new setting.

(26) Purge the low pressure calibration reservoir until the "CO2 Occlusion" message is displayed on the monitor.

(27) Disconnect the sample tubing from the water trap.

(28) Repeat steps "2" through "27" above for each remaining gas to be calibrated.

(29) Press the <Esc> key to display the Normal Screen.

h. Perform Agents Verification (see Section 5: Page 5-30, paragraph 5.6.7).

SECTION 7
MAINTENANCE

7.0 MAINTENANCE.

CAUTION

The **3160 Patient Monitors** contain Static Sensitive circuits. Proper handling procedures must be followed when touching any Printed Circuit Board (PCB) as static voltages usually present on clothing and personnel present great risk of damage to the circuits. **All Service Procedures *MUST* be performed by Properly Grounded Personnel at a Static-Free Work Station**.

7.1 Introduction. This section includes a comprehensive test equipment list, as well as procedures for conducting preventive/corrective maintenance and cleaning on the **3160 Series MRI Physiological Monitor**. Software update/cold start procedures; assembly/disassembly procedures; battery tests and guidelines for using the Spare Parts List in Section 10 of this manual (and the Maintenance Drawings provided in Appendix J) to identify and order replacement parts for the monitor are also provided in this section.

7.2 Required Test Equipment. The following general purpose test equipment is required to perform field calibration, verification, adjustment and preventive/corrective maintenance procedures on the Model **3160** monitors:

NOTE

For convenience, procedures that require test measurements are marked throughout this manual with the symbols that represent each piece of general-purpose test equipment (i.e., DMM, Oscilloscope, etc.). The graphic content of the test equipment displays is generic and does not necessarily depict the actual test readings and/or waveforms to be observed.

- Digital Multimeter (DMM)
- IBM-compatible VGA/SVGA pc monitor
- IBM-compatible standard pc keyboard
- Pressure Manometer
- Patient Simulator (ECG: 60-300 BPMs, 0.5 to 2 mV amplitude, 1mV square wave at 2 Hz)
- 40 foot NIBP Hose
- Pressure Simulator (0 to 250 mmHg)

7.2.1 EtCO2 Test Equipment. The following test equipment is only required if the monitor contains the EtCO2 option:

- Calibration Gas (see Section 10 for Invivo gas can part numbers)
- Air Flow Meter (0 to 300 mL/minute)

7.2.2 Agents Test Equipment. The following test equipment is only required if the monitor contains the Agents (with EtCO2) option:

- Check Gas Canisters (see Section 10 for Invivo gas can P/N's)
- Span Cal Gas Kits (see Section 10 for Invivo gas kit P/N's)
- Air Flow Meter (0 to 300 mL/minute)

7.2.3 Fiber Optic Temperature Test Equipment. The following equipment is only required if the monitor contains the Fiber Optic (F.O.) Temperature option:

- 21°C Fiber Optic Temperature Reference Probe (FISO P/N TRP-INV1 21°C)
- 37°C Fiber Optic Temperature Reference Probe (FISO P/N TRP-INV1 37°C)
- 43°C Fiber Optic Temperature Reference Probe (FISO P/N TRP-INV1 43°C)

7.2.4 Respiration Test Equipment. The following test equipment is only required if the monitor contains the Respiration option:

- Pillow Sensor (Bellows)

7.3 Preventive Maintenance. Preventive maintenance procedures are those procedures recommended for performance on a periodic basis in order to minimize equipment failure and prevent unnecessary repairs on the monitor. The following subparagraphs describe the various periodic maintenance tasks for the monitor, and prescribe the frequency with which each task should optimally be performed. (See Appendix I for an optional chart that can be used by the maintenance technician to help schedule and track these tasks.)

7.3.1 Patient Module Battery Charging (Every 8 Hours of Use). Charge the Patient Module batter(ies) (see Section 3: Page 3-19, paragraph 3.3.1(f)).

7.3.2 Monitor Calibration and Verification (Every 6 Months). Perform the Calibration and Verification Procedures for the monitor (see Section 5). If abnormal indications are observed, perform the related Adjustment Procedures (see Section 6).

7.3.3 Monitor Cleaning - External (Every 6 Months). Clean the outside of the monitor (see Page 7-11, paragraph 7.7.1(a)).

7.3.4 Monitor Adjustment (Every 12 Months). Perform the Adjustment Procedures for the monitor (see Section 6).

7.3.5 Monitor Cleaning - Internal (Every 12 Months). Clean the inside of the monitor (see Page 7-11, paragraph 7.7.1(b)).

7.3.6 Battery Tests (Every 12 Months). Perform the Battery Tests (see Page 7-18, paragraph 7.10).

7.3.7 Consumable Parts (Every 12 Months). Replace the following consumable items with new parts (see Section 10 of this manual for corresponding part numbers):

a. WPU/DCU 14.4V Lithium Ion Battery (4 each).

(Refer to Page 7-15, paragraph 7.8.4 for procedures to replace the 14.4V LI Batteries.)

b. WECG/WSPO2 Patient Module 4.1V LI Batteries (2 each).

(Refer to Page 7-15, paragraph 7.8.5 for procedures to replace the 4.1V LI Batteries.)

c. (Agent Option Only) 3160 Water Trap.

(Refer to the **3160 Series MRI Physiological Monitor Operations Manual**, Invivo Part Number 9569, for procedures to replace the Water Trap.)

d. (Agent Option Only) WPU Disposable Anesthetic Oxygen Sensor.

(Refer to Page 7-16, paragraph 7.8.10 for procedures to replace the Oxygen Sensor.)

7.4 Corrective Maintenance. Corrective maintenance consists of all procedures required to return the equipment to normal operation in the event of a malfunction. Troubleshooting Procedures for common symptoms that may be observed while operating, or attempting to operate, the 3160 monitor in the field are provided in Section 9 of this manual. The maintenance technician should locate the symptom observed in the "Fault Index" first, and then perform the associated steps in the Troubleshooting Procedures in the order presented until directed to replace a defective box, cable or hose. Upon successful replacement of a faulty assembly, the applicable System Test and Verification (see paragraph 7.4.1 below) should be performed to ensure the equipment has been restored to a condition of operational readiness before returning the monitor to operation.

7.4.1 System Test and Verification. The System Test and Verification Procedures (Table 7-1) identify the specific checks to be performed on the equipment following the field replacement of defective parts. When the "Troubleshooting Flow" in Section 9 directs the maintenance technician to perform the "System Test and Verification" procedures for a particular replacement action, reference should be made to Table 7-1 below to identify the final Checks to be run for the indicated replacement action.

Table 7-1. 3160 Monitor Field System Test and Verification Procedures

Replaced Part	Check(s)
AS215 WPU Electrical Assembly (Includes replaced Oxygen Sensor, Water Trap, WECG/WSPO2 Transmitter Modules with batteries, WPU batter(ies), DC Fuse)	Confirm normal operation of the WPU Electronics Assembly as follows: a. If the WPU was replaced, perform a ZERO CAL from the Service (Bio-Med) Menu's GAS CAL option (see Section 3: Page 3-14, paragraph 3.3.1, menu option b(4)(a)). b. If the O2 sensor was replaced, perform an O2 INIT CAL from the Service (Bio-Med) Menu's GAS CAL option (see Section 3: Page 3-15, paragraph 3.3.1, menu option b(4)(e)). c. Perform Operational Quick Checks (see Section 2: Page 2-3, paragraph 2.6). d. Perform WPU Verification (see Section 5: Page 5-13, paragraph 5.6).
AS240 DCU Display Assembly (Includes replaced DCU batter(ies), DC Fuse)	Confirm normal operation of the DCU Display Assembly as follows: a. Perform Operational Quick Checks (see Section 2: Page 2-3, paragraph 2.6). b. Perform DCU Verification (see Section 5: Page 5-1, paragraph 5.4).
AS219 PCU (Includes replaced AS226 IBP Assembly)	Confirm normal operation of the PCU Assembly as follows: a. Perform Operational Quick Checks (see Section 2: Page 2-3, paragraph 2.6). b. Perform PCU Verification (see Section 5: Page 5-11, paragraph 5.5).
AS201 Power Adapter (Includes replaced AC Fuse(s))	Confirm normal operation of the Power Adapter Assembly as follows: a. Perform Operational Quick Checks (see Section 2: Page 2-3, paragraph 2.6). b. Perform Power Adapter Verification (see Section 5: Page 5-1, paragraph 5.3).

7.5 Software Installation. The **3160 Series MRI Physiological Monitor** is equipped with USB ports on the WPU and DCU assemblies into which solid state flash drive units can be inserted for update/upgrade of the monitor software.

7.5.1 Program Update/Upgrade. Perform the following procedure to Update/Upgrade the monitor software using the Invivo flash drive(s):

a. **DCU Program Update.** Updating the programmable elements of the 3160 DCU is accomplished through the use of one or more USB flash memory drives which contain the software and other data used by the DCU. During the reprogramming process, the

DCU will not function as a patient monitoring device. Patient monitoring capability will be restored only once the reprogramming process has successfully completed and the DCU has been powered off and then back on, and is once again communicating with a WPU containing a compatible program.

The following is a step-by-step procedure for reprogramming the DCU:

(1) Detach the DCU from the MRI pole.

(2) Remove the service panel on the rear of the DCU.

(3) Connect the AS201 Power Adapter to the DCU unit and insert at least one (1) fully charged battery into the DCU battery compartment.

(4) Turn ON the DCU and wait until the Normal Screen is displayed. (The DCU need not be communicating with a WPU for it to be reprogrammed.)

(5) Prior to inserting the USB device to update software, ensure that you have entered NAV mode by typing "nav" on an attached keyboard.

(6) Insert the USB program update flash drive containing the desired program(s) into the USB connector on the rear of the unit. If the USB drive is a valid Invivo program update device, the DCU will display the DCU Program Update Window, which will list the DCU program elements and any other pertinent data contained on the USB drive. You will also be given a choice of whether or not to proceed with the reprogramming. An example of this dialog window is shown in Figure 7-1.

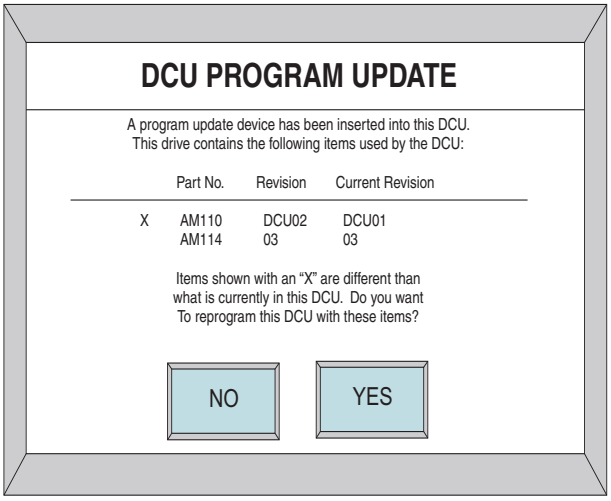


Figure 7-1. Sample DCU Program Update Dialog Window

(7) Turn the Rotary Knob to highlight either the **YES** or **NO** in the Reprogramming Dialog Window. When the desired option is highlighted, push the rotary knob to select that option. Selecting **NO** will cause reprogramming to be cancelled, and the dialog window shown in Figure 7-1 will disappear.

In this case, remove the USB flash drive from the rear of the unit. Press the Rotary Knob to remove this dialog window from the display. Normal functionality of the DCU will be restored, and the DCU may be used as it normally would.

(8) Selecting **YES** in the DCU Program Update Window will cause DCU reprogramming to commence.

CAUTION

Power can not be interrupted while the USB flash drive is reprogramming your DCU. Do no turn power off to the DCU or remove the flash drive from the USB port during a software update. If reprogramming is interrupted, refer to subparagraph "b" to determine if the program can be recovered or the DCU must be returned to Invivo Technical Service for internal programming.

(9) Once reprogramming has begun, the DCU Program Update Dialog Window will change to show the current progress of reprogramming. An example of this is shown in Figure 7-2.

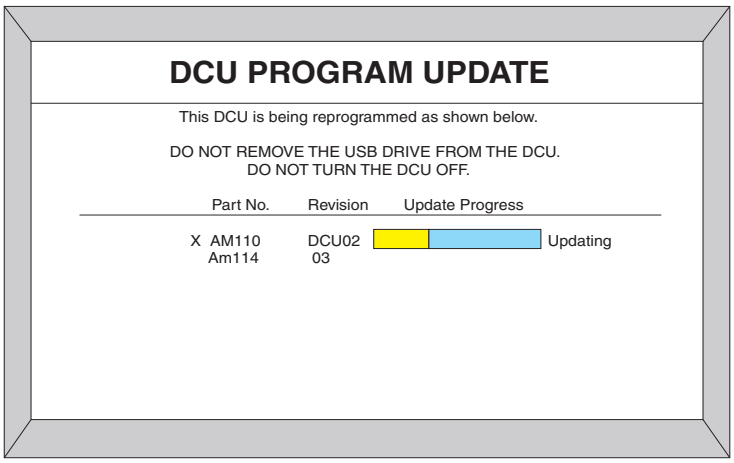


Figure 7-2. DCU Program Update Dialog Window - Update In Progress

(10) Reprogramming will continue until the DCU has been reprogrammed with all applicable program elements that were contained on the USB drive. When reprogramming has completed, the DCU Program Update Window will change to reflect this, as shown in Figure 7-3. When this dialog is displayed, turn the DCU off and then remove the USB flash drive from the rear of the unit.

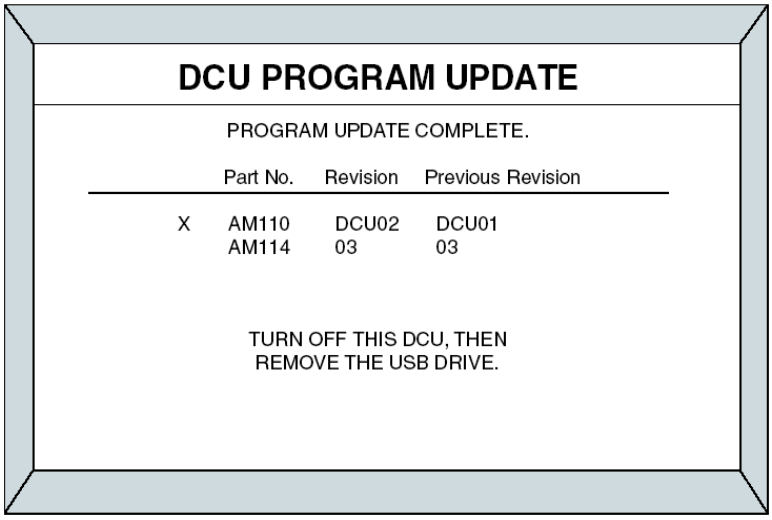


Figure 7-3. DCU Program Update Window - Update Completed

(11) Ensure the USB drive has been removed from the DCU, and then turn the DCU back on. When the Normal Screen is shown, press the **SETUP** Control Key. Turn the Rotary Knob until the **SERVICE (BIO-MED)** item is highlighted, then press the knob.

(12) When the SERVICE (BIO-MED) menu appears, turn the Rotary Knob until the **SW ID** item is highlighted and press the knob once again. In the window that is now displayed, verify that the DCU contains the expected program elements. If so, replace the DCU's rear panel cover. If not, repeat this reprogramming procedure. If, after repeating this procedure, the unit is still not programmed correctly, contact Invivo Technical Support for further instructions.

b. **DCU Program Recovery.** If the reprogramming of a DCU is interrupted or halted due to the DCU losing power or the removal of the USB program update device, it is possible that the unit may no longer function properly. To determine if the DCU is still functional when this has happened, perform the procedure below:

(1) If the DCU is currently powered ON, turn it OFF.

(2) If the USB program update device is still inserted into the DCU, remove it.

(3) Turn the DCU ON. If the Normal Screen does not appear within one minute, the DCU is no longer functional.

(4) If the DCU is functional, repeat the normal DCU Program Update procedure give in subparagraph "a" to ensure that the DCU is currently reprogrammed with all necessary program elements on the USB program update device.

(5) If the DCU is not functional, perform the following procedure:

(a) Turn the DCU OFF.

(b) Insert the USB program update device into the USB connector on the rear of the DCU.

(c) Turn the DCU ON. The Invivo splash screen will appear, and then the following text will be displayed:

DCU OPERATIONAL PROGRAM UPDATE IN PROGRESS.
DO NOT REMOVE USB DRIVE FROM DCU!

0. . . . 1 . . . . 2 . . . . 3 4

(d) The unit will begin reprogramming the operational software from the USB device. A series of "X" characters will appear below the number scale, indicating the progress of reprogramming. Do not turn off the DCU, and do not remove the USB device from the unit while reprogramming is in progress.

(e) When reprogramming is complete, the following text will be displayed:

DCU OPERATIONAL PROGRAM UPDATE COMPLETE.
TURN DCU OFF, THEN REMOVE USB DRIVE.

(f) When this text appears, turn OFF the DCU and remove the USB device from the rear of the unit.

(g) Turn the DCU back ON, verify that the Normal Screen is displayed, and proceed to step "h" below. If the Normal Screen does not appear after one minute, contact Invivo Technical Support for further assistance.

(h) To ensure that the DCU is reprogrammed with all necessary program elements on the USB program update device, repeat the normal DCU Program Update procedure given in subparagraph "a".

c. **WPU Program Update.** Updating the programmable elements of the 3160 WPU is accomplished through the use of one or more USB flash memory drives which contain the software and other data used by the WPU. A DCU is also required for WPU reprogramming to serve as the user interface. During the reprogramming process, the WPU being reprogrammed and the DCU being used will not function as patient monitoring devices. Patient monitoring capability will be restored only once the reprogramming process has successfully completed and the WPU has been powered off and then back on, and is once again communicating with a DCU containing a compatible program.

The following is a step-by-step procedure for reprogramming the WPU:

(1) Attach the DCU to the MRI pole.

(2) Open the service panel on the rear of the WPU.

(3) Connect the AS201 Power Adapter to the WPU unit and insert at least one (1) fully charged battery into the WPU battery compartment.

(4) Turn ON the DCU and wait until the Normal Screen is displayed. Ensure that the DCU is set to the same communication Network Number as the WPU. This number is displayed in the lower, right corner of the DCU.

(5) To change the DCU's network setting, press the SETUP Control Key. Turn the Rotary Knob until the S**ERVICE (BIO-MED)** item is highlighted, then press the knob. When the SERVICE (BIO-MED) menu appears, turn the Rotary Knob until the **NETWORK** item is highlighted and press the knob. Turn the Rotary Knob to highlight the desired network number and then press the knob to set the network.

(6) Turn ON the WPU, and wait until communication has been established with the DCU being used. (It is important that communication be maintained between the WPU being reprogrammed and the DCU. If communication is lost during reprogramming, the DCU will return to functioning as a normal patient monitoring device until communication is once again established with the WPU. The WPU will continue its reprogramming, even if communication is lost.)

(7) Prior to inserting the USB device to update software, ensure that you have entered NAV mode by typing "nav" on an attached keyboard

(8) Insert the USB program update flash drive containing the desired program(s) into the USB connector on the rear of the WPU. If the USB drive is a valid Invivo program update device, the DCU will display the WPU Program Update Dialog Window, which will list the WPU program elements and any other pertinent data contained on the USB drive. You will also be given a choice of whether or not to proceed with the reprogramming. An example of this dialog window is shown in Figure 7-4.

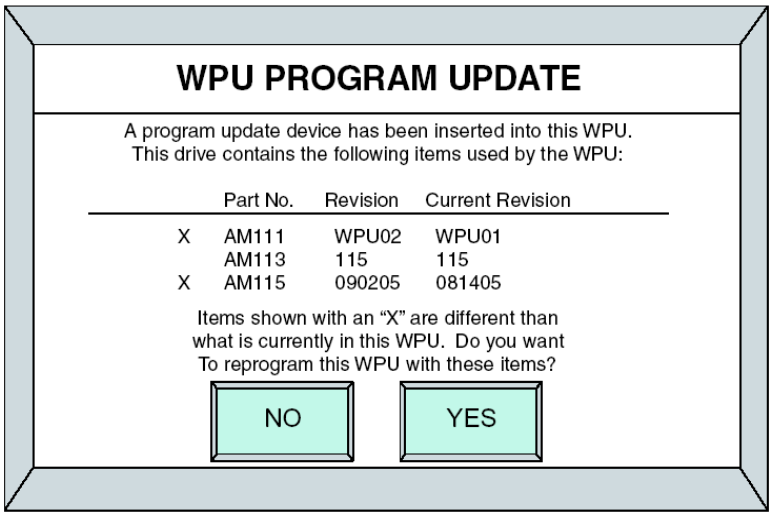

WPU PROGRAM UPDATE
A program update device has been inserted into this WPU.
This drive contains the following items used by the WPU:
Part No. Revision Current Revision
X AM111 WPU02 WPU01
AM113 115 115
X AM115 090205 081405
Items shown with an "X" are different than
what is currently in this WPU. Do you want
To reprogram this WPU with these items?
NO
YES

Figure 7-4. Sample WPU Program Update Dialog Window

(9) Turn the Rotary Knob to highlight either the YES or NO in the Reprogramming Dialog Window. When the desired option is highlighted, push the Rotary Knob to select that option. Selecting NO will cause reprogramming to be cancelled, and the dialog window shown in Figure 7-4 will disappear.

In this case, remove the USB flash drive from the rear of the unit. Press the Rotary Knob to remove this dialog window from the display. Normal functionality of the DCU will then be restored, and the WPU may be used as it normally would.

(10) Selecting **YES** in the WPU Program Update Window will cause the WPU reprogramming to commence.

CAUTION

Power can not be interrupted while the USB flash drive is reprogramming your WPU. Do no turn power off to the WPU or remove the flash drive from the USB port during a software update. If reprogramming is interrupted, refer to subparagraph "d" to determine if the program can be recovered or the WPU must be returned to Invivo Technical Service for internal programming.

(11) Once reprogramming has begun, the WPU Program Update Dialog Window will change to show the current progress of reprogramming. An example of this is shown in Figure 7-5.

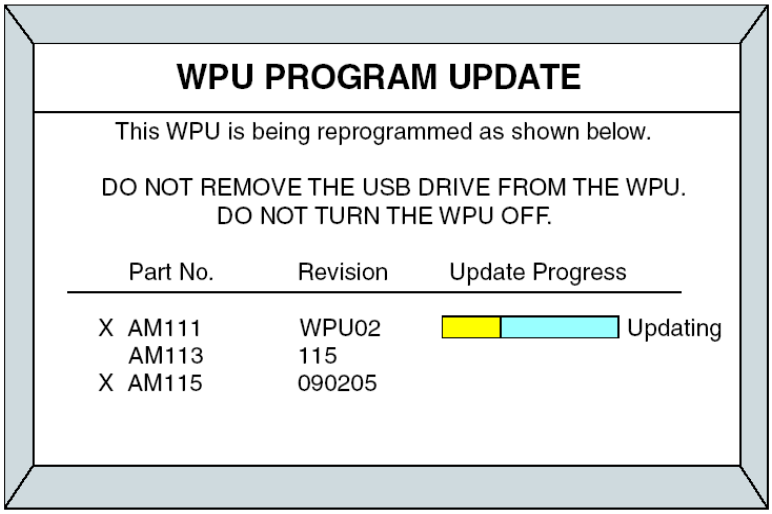


Figure 7-5. WPU Program Update Dialog Window - Update In Progress

(12) Reprogramming will continue until the WPU has been reprogrammed with all applicable program elements that were contained on the USB drive. When reprogramming has completed, the WPU Program Update Window will change to reflect this, as shown in Figure 7-6. When this dialog is displayed, turn the WPU OFF and then remove the USB flash drive from the rear of the unit.

(13) The WPU Program Update Window is removed from the display.

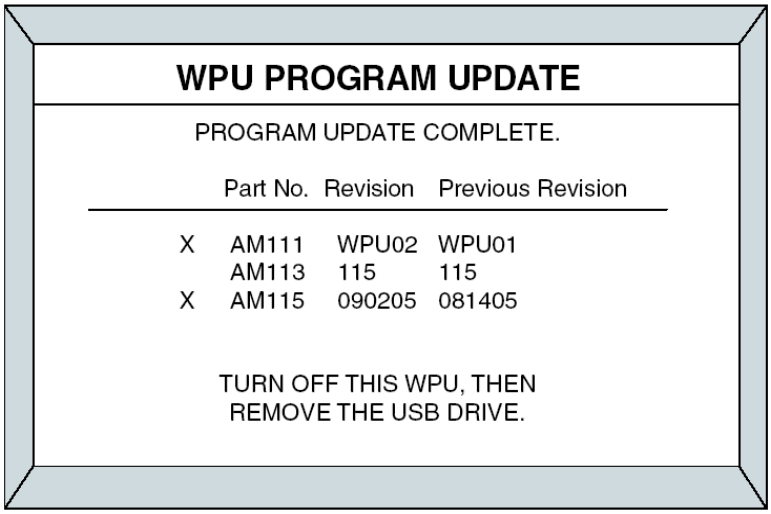


Figure 7-6. WPU Program Update Window - Update Completed

(14) Ensure the USB drive has been removed from the WPU, and then turn the WPU back ON. When the WPU has established communication with the DCU and the Normal Screen is displayed, press the **SETUP** Control Key. Turn the Rotary Knob until the **SERVICE (BIO-MED)** item is highlighted, then press the knob.

(15) When the SERVICE (BIO-MED) menu appears, turn the Rotary Knob until the **SW ID** item is highlighted and press the knob once again. In the window that is now displayed, verify that the WPU contains the expected program elements. If so, close the WPU's rear panel cover. If not, repeat this reprogramming procedure. If, after repeating this procedure, the unit is still not programmed correctly, contact Invivo Technical Support for further instructions.

d. **WPU Program Recovery.** If the reprogramming of a WPU is interrupted or halted due to the WPU losing power or the removal of the USB program update device, it is possible that the unit may no longer function properly. To determine if the WPU is still functional when this has happened, perform the procedure below:

(1) If the WPU is currently powered ON, turn it OFF.

(2) If the USB program update device is still inserted into the WPU, remove it.

(3) Turn the WPU on. If the DCU that is being used with the WPU does not show that communication with the WPU has been established within one (1) minute, it is likely that the WPU is no longer functional.

(4) If the WPU is functional, repeat the normal WPU Program Update procedure given in subparagraph "c" to ensure that the WPU is correctly reprogrammed with all necessary program elements on the USB program update device.

(5) If the WPU is not functional, perform the following procedure:

(a) Turn the WPU OFF.

(b) Attach a standard VGA computer monitor to the VGA output located behind the service panel of the WPU. Plug the monitor into an AC power source, and then turn the monitor ON.

(c) Insert the USB program update device into the USB connector on the WPU.

(d) Turn the WPU ON. The Invivo splash screen will appear on the monitor, and then the following text will be displayed:

WPU OPERATIONAL PROGRAM UPDATE IN PROGRESS.
DO NOT REMOVE USB DRIVE FROM WPU!

0. . . . 1 . . . . 2 . . . . 3 4

(e) The unit will begin reprogramming the operational software from the USB device. A series of "X" characters will appear below the number scale, indicating the progress of reprogramming. Do no turn off the WPU, and do not remove the USB device from the unit while reprogramming is in progress.

(f) When reprogramming is complete, the following text will be displayed:

WPU OPERATIONAL PROGRAM UPDATE COMPLETE.
TURN WPU OFF, THEN REMOVE USB DRIVE.

(g) When this text appears, turn OFF the WPU and remove the USB device from the rear of the unit.

(h) Turn the WPU back ON, and wait for the Normal Screen to be displayed on the monitor connected to the WPU. Also verify that the DCU shows that communication has been established with the WPU. If both of these conditions are met, turn off the VGA monitor and disconnect the monitor from the WPU, then continue with step "i" below. Otherwise, contact Invivo Technical Support for further assistance.

(i) To ensure that the WPU is reprogrammed with all necessary program elements on the USB program update device, repeat the normal WPU Program Update procedure given in subparagraph "c".

7.6 DCU Cold Start. Perform the following procedure to cold start the DCU unit:

a. Set the Power Switch on the DCU to the OFF ( ) position.

b. Press and hold the Rotary Knob while turning the DCU Power Switch to ON ( ).

c. When the DOS prompt appears in the upper left corner of the display screen (in approximately 10-15 seconds) release the Rotary Knob, then immediately press and hold the **NORMAL SCREEN** Control Key.

d. When the Cold Start banner is momentarily displayed, release the **NORMAL SCREEN** Control Key.

7.7 Cleaning. Instructions for cleaning the monitor and accessories are provided in the following paragraphs.

7.7.1 Monitor. Clean and inspect the monitor in accordance with the following steps:

WARNING

Electrical shock hazard: Turn off the monitor and disconnect AS201 DC Input power before cleaning. Do not immerse the monitor in any water or liquid for any reason. Do not apply excessive pressure to the monitor control panel display screen.

a. **External Cleaning.** Clean and inspect the outside of the monitor as indicated below:

(1) Unplug the monitor before cleaning.

(2) Remove dirt and dust from the unit by wiping it with a soft, damp cloth.

(3) Remove stains from the case by scrubbing it briskly with a damp cloth.

(4) Inspect all external components/surfaces for the following items:

(a) Switches and controls for proper mechanical operation and no binding.

(b) Outer panels for physical damage (e.g., dents, cracks, etc.).

(c) Legible panel/switch stenciling.

CAUTION

Do not immerse the monitor in any water or liquid for any reason.

(5) Allow the unit to dry completely before returning it to operation.

b. **Internal Cleaning.** Clean and inspect the inside of the monitor as indicated below:

(1) Disassemble the DCU as follows:

(a) Ensure that the **3160** monitor is turned OFF, and AS201 DC Input power is disconnected.

(b) Remove the 9064 backup batteries from the DCU and WPU battery compartments.

(c) Lift the DCU out of the retaining slot at the top of the MRI pole.

(d) On a workbench, remove front panel assembly from the DCU (10 screws).

(e) Remove the RF antenna wire from the front panel.

(1) Disassemble the WPU as follows:

(a) Loosen two (2) captive screws securing the plastic WPU rear access panel to the WPU base.

(b) Remove the rear access panel.

(c) Remove the outer plastic cover from the WPU Electronics Assembly (4 small screws on underside of WPU base).

(2) Using a stream of compressed air and a non-conductive hose/applicator, carefully eliminate deposits of dust or other debris from the inside of the monitor.

(3) Inspect all internal components for the following:

(a) Securely fastened hardware (e.g., nuts, bolts, screws, brackets, etc.).

(b) Circuit cards/plug-in modules installed and firmly seated.

(c) All electrical connections, wiring and cables secured with no cuts, breaks, frayed insulation, or excessive strain.

(d) No crimped or loose air hoses/tubing.

(e) No torn, cracked or worn EMI gaskets (see Page 7-15, paragraph 7.8.3).

(4) Reassemble the monitor as required.

7.7.2 Accessories. Any reusable patient accessories should be cleaned after each use. Disposable patient accessories should be discarded and replaced with new items. Clean reusable accessories in accordance with the following steps:

a. Remove the accessory from the monitor.

b. Remove any dirt or debris using soap and water. Avoid immersing accessory in any fluid for cleaning.

c. Inspect the accessory for any cracks, holes, tears, cuts, etc., that could affect operation, and replace as necessary.

d. If disinfection is required, use only the recommended liquid surface disinfectants, unless otherwise specified in the accessories listing (refer to the **3160 Series MRI Physiological Monitor Operations Manual**, Invivo Part Number 9569). Recommended surface disinfectants include dilute solutions of either quaternary ammonium compounds, iodophors or gluteraldehydes.

7.8 Assembly/Disassembly Procedures. The following paragraphs provide assembly and disassembly procedures for the field replaceable assemblies and consumable items contained in the **3160** monitor.

WARNING

Electrical shock hazard: Prior to removing any assemblies from the **3160** monitor, ensure that power to the monitor has been turned OFF, the AS201 Power Adapter is unplugged and the batteries have been removed. Failure to comply can result in serious injury or death to personnel, and/or damage to the monitor's internal circuits.

7.8.1 Required Tools. The following tools are required to assemble/disassemble this monitor:

- #1 Phillips Head Screwdriver
- Small Flathead Screwdriver

NOTE

RF SHIELDING: For proper operation within the MRI area, this Monitor is constructed with extensive RF shielding to contain and prevent leakage of internal RF frequencies. Care should be taken during disassembly and assembly to ensure that the EMI gaskets are not damaged. Any worn or damaged DCU EMI gaskets should be replaced to ensure integrity of the RF seal (see Page 7-15, paragraph 7.8.3).

7.8.2 3160 Monitor Disassembly/Reassembly. Perform the following steps to remove/replace the following major assemblies on the **3160** monitor.

a. **AS240 DCU Removal/Replacement.** Perform the following procedure to remove/replace the AS240 DCU Display Assembly:

(1) Remove power from the **3160** monitor by disconnecting it from the AS201 AC Power Adapter.

(2) Remove the 9064 backup batteries from the DCU rear battery compartments.

(3) Lift the DCU out of the retaining slot at the top of the MRI pole.

(4) Reverse the above steps to install a replacement AS240.

NOTE

The PCU also includes the pole mount bracket, connector panel and front/rear covers with mounting hardware, as well as the AS226 IBP Assembly when the IBP option is installed (see Appendix H: Figure H-4 for component locations).

b. **AS219 PCU Removal/Replacement.** Perform the following procedure to remove/replace the AS219 PCU Assembly:

(1) Remove power from the **3160** monitor by disconnecting it from the AS201 AC Power Adapter.

(2) Remove the 9064 backup batteries from the WPU base.

(3) Remove the rear plastic cover from the PCU assembly (4 screws).

(4) Remove the metal PCU connector panel (with PCU and all wires/hoses attached) from the metal PCU pole mount bracket (5 screws), temporarily leaving the mounting bracket securely bolted to the MRI pole.

(5) Carefully disconnect all wires/hoses (exiting the upper hole in the MRI pole) from the PCU connector panel (all connections are marked).

(6) If the IBP option is installed, carefully disconnect all wires/hoses from the AS226 assembly (all connections are marked).

(7) Remove the metal PCU pole mount bracket from the MRI pole (2 bolts).

(8) Reassemble the unit as follows:

(a) Reinsert the 2 bolts into their mating holes on the PCU pole mount bracket and finger tighten into the threaded flanges.

(b) Reattach the PCU connector panel to the PCU pole mount bracket (5 screws).

(c) Reinstall the rear plastic cover onto the PCU pole mount bracket (4 screws).

(9) Reverse the above steps to install a replacement AS219.

CAUTION

The following steps provide a procedure for removing the AS215 WPU Electronics Assembly from the WPU base as a *sealed unit*. Invivo Corporation assumes no liability for loss of integrity to the RF seal once the seal is compromised, or for any damage to internal parts that may be caused by attempting circuit board field repair inside the unit.

c. **AS215 WPU Electronics Assembly Removal/Replacement.** Perform the following procedure to remove/replace the AS215 WPU Electronics Assembly:

(1) Remove power from the **3160** monitor by disconnecting it from the AS201 AC Power Adapter.

(2) Remove the 9064 backup batteries from the WPU base.

(3) Loosen two (2) captive screws securing the plastic WPU rear access panel to the WPU base.

(4) Remove the rear access panel.

(5) Remove the outer plastic cover from the WPU (4 small screws on underside of WPU base).

(6) Carefully disconnect all wires/hoses (exiting the lower hole in the MRI pole) from the WPU Electronics assembly (all connections are marked).

(7) Carefully disconnect the battery cable from the WPU Electronics assembly (the connection is marked).

(8) Unscrew and remove Antenna HE61 from Telemetry Antenna Cable AC543.

(9) Remove the 4 large screws from the underside of the WPU base.

(10) Carefully lift the AS215 WPU Electronics Assembly out of the WPU base.

(11) Reverse the above steps to install a replacement AS215.

7.8.3 DCU EMI Gasket Removal/Replacement. If upon routine inspection of the DCU Display Assembly (see Page 7-11, paragraph 7.7.1(b)) the front panel EMI gaskets are torn or show evidence of excessive wear, replace the gaskets as follows:

NOTE

Pulling or stretching the DCU gaskets may crack or otherwise damage the material.

a. Remove power from the **3160** monitor by disconnecting it from the AS201 AC Power Adapter.

b. Remove the 9064 backup batteries from the DCU battery compartments.

c. Replace the two EMI gaskets on the front panel assembly as follows (see Appendix H: Figure H-2 for component locations):

(1) Perform Page Page 7-13, paragraph 7.8.2(a) to remove the DCU Display Assembly.

(2) On a workbench, remove the front panel assembly from the DCU (10 screws).

(3) Remove the RF antenna wire from the front panel.

(4) Peel off the existing EMI gaskets around the perimeters of the display and handle.

(5) Carefully insert the replacement gaskets (Invivo Part Number H165) one at a time into their respective grooves.

(6) Press each gasket into place, ensuring it is firmly seated in its groove all the way around its perimeter.

7.8.4 WPU/DCU 9064 Battery Removal/Replacement. Remove the batter(ies) as follows:

a. On the WPU, replace the batteries as follows:

(1) Press the adjacent release button on the left or right side of the base to disengage the battery latch.

(2) Slide the battery pack out of the battery compartment in the base.

(3) To replace the battery, slide it all the way into the housing until the battery latch is engaged.

(4) Dispose of used battery pack(s) as specified in the "BATTERY PACK SERVICE PRECAUTIONS AND DISPOSAL" procedures located in the front of this manual.

b. On the DCU, replace the batteries as follows:

(1) Press the associated release button on the rear panel of the display to disengage the battery latch.

(2) Slide the battery housing out of the battery compartment in the side of the display.

(3) To replace the battery, slide it all the way into the housing until the battery latch is engaged.

(4) Dispose of used battery pack(s) as specified in the "BATTERY PACK SERVICE PRECAUTIONS AND DISPOSAL" procedures located in the front of this manual.

7.8.5 WECG/WSPO2 9065 Patient Module LI Battery Removal/Replacement. Remove the batter(ies) as follows:

a. Press the two release latches on the battery to disengage the battery housing from the wireless module.

b. Slide the battery out of the battery compartment.

c. To replace the battery, slide it all the way into the wireless module until the battery latches are engaged.

7.8.6 WPU FU39 DC Fuse Removal/Replacement. Remove the in-line DC fuse as follows:

a. Turn monitor power OFF.

b. Pull the 5A, 32V fuse out of the fuse housing on the rear panel of the WPU base.

c. Reverse step "b" to install a replacement fuse.

7.8.7 DCU FU39 DC Fuse Removal/Replacement. Remove the in-line DC fuse as follows:

a. Turn monitor power OFF.

b. Loosen three (3) screws securing the DCU rear access panel to the DCU case.

c. Remove the rear access panel from the DCU case.

d. Pull the 5A, 32V fuse out of the fuse housing on the rear panel of the DCU case.

e. Reverse steps "b" through "d" to install a replacement fuse.

7.8.8 AS201 Power Adapter Removal/Replacement. Remove the AS201 Power Adapter as follows:

a. Turn monitor power OFF.

b. Disconnect AS201 DC Power Adapter cable AC517 from the **3160** (WPU or DCU unit) and **AS201** DC power ports.

c. Disconnect AS201 DC Power Adapter from the AC wall outlet.

d. Reverse the above steps to install a replacement AC power adapter.

7.8.9 AS201 FU12 AC Fuse Removal/Replacement. Remove the main AC fuse(s) on the AS201 as follows:

a. Perform steps on Page 7-16, paragraph 7.8.8 to remove the AS201 assembly.

b. Gently disengage the Line Filter (HE98) access door (located next to the AC Input power receptacle) from the top of the HE98 rear housing, and swing the door open on its hinges.

c. Carefully remove the fuse(s) by grasping the fuse holder(s) and pulling the fuse/holder set(s) out of the HE98 housing.

d. Remove the 1.5A, 250V fuse(s) from the holder(s).

e. Reverse the above steps to reassemble the HE98.

7.8.10 WPU 9445 Disposable Anesthetic Oxygen Sensor Removal/Replacement. Remove the optional anesthetic oxygen sensor as follows:

a. Disconnect AS201 from the WPU (if attached).

b. Remove WPU batteries.

c. Loosen two (2) captive screws securing the plastic WPU rear access panel to the WPU base.

d. Remove the rear access panel.

e. Unplug adapter cable assembly from top of disposable oxygen sensor.

f. Unscrew oxygen sensor from threaded port on the O2 Sensor Assembly.

g. Screw replacement disposable oxygen sensor into the threaded port on the O2 Sensor Assembly. (Hand tighten only.)

h. Plug adapter cable assembly into top of disposable oxygen sensor.

i. Reinstall the rear access panel and tighten the two captive screws.

7.8.11 DCU HE61 Radio Antenna Removal/Replacement. Remove the HE61 radio antenna as follows:

a. Unscrew Antenna HE61 from Telemetry Antenna Cable AC543.

b. Reverse the above step to install a replacement antenna.

7.8.12 WPU HE61 Radio Antenna Removal/Replacement. Remove the HE61 radio antenna as follows:

a. Remove power from the **3160** monitor by disconnecting it from the AS201 AC Power Adapter.

b. Remove the 9064 backup batteries from the WPU base.

c. Loosen two (2) captive screws securing the plastic WPU rear access panel to the WPU base.

d. Remove the rear access panel.

e. Remove the outer plastic cover from the WPU Electronics assembly (4 small screws on underside of WPU base).

f. Unscrew Antenna HE61 from Telemetry Antenna Cable AC543.

g. Reverse the above step to install a replacement antenna.

7.9 Maintenance Access Procedures. The following paragraphs provide equipment setup procedures for obtaining maintenance access to the internal components of the **3160** monitor while operating the monitor with power applied. When specified, these procedures should be performed in the sequence presented below to facilitate equipment testing and various corrective maintenance tasks.

WARNING

Electrical shock hazard: Prior to performing the following procedures, ensure that power to the monitor has been turned OFF, the AS201 Power Adapter is unplugged and the batteries have been removed. Failure to comply can result in serious injury or death to personnel, and/or damage to the monitor's internal circuits.

CAUTION

The following steps provide a procedure for obtaining access to the AS239 WPU Base Assembly for the purposes of troubleshooting/testing its internal components, but *do not* permit access to the circuit cards located inside the AS215 Electronics Assembly. Invivo Corporation assumes no liability for loss of integrity to the AS215 assembly's RF seal once the seal is compromised, or for any damage to internal parts that may be caused by attempting circuit board field repair inside the unit.

7.9.1 WPU Maintenance Access. Perform the following steps to gain maintenance access to the AS239 WPU Base Assembly:

a. Ensure that the Power Switches on the PCU and DCU are set to the OFF (⏻) position.

b. Remove the 9064 backup batteries from the WPU base.

c. Perform steps on Page 7-13, paragraph 7.8.2(a) to remove the AS240 DCU Display assembly.

d. Loosen two (2) captive screws securing the plastic WPU rear access panel to the WPU base.

e. Remove the rear access panel.

f. Remove the outer plastic cover from the WPU base (4 screws).

7.9.2 DCU Maintenance Access. Perform the following steps to gain maintenance access to the AS240 DCU Display Assembly:

a. Perform steps on Page 7-17, paragraph 7.9.1 to gain maintenance access to the WPU Assembly.

b. On a workbench, remove the front panel assembly from the DCU (10 screws).

c. Plug the **AS201** power cord into a hospital grade AC outlet.

d. Plug the other end of the power cord into the AC Input power connector on the **AS201 Power Adapter**.

e. Plug the 3160 power cable, AC517, into the **AS201** and WPU DC power port.

f. Reinstall the batteries in the WPU base and DCU rear battery compartments.

g. Set the Power Switches on the WPU and DCU to the ON (⊙) position (the monitor powers up with the WPU running on **AS201** +18 Vdc output power and the DCU operating on 9064 +14 Vdc backup battery power).

7.10 Battery Tests. Perform the following tests to check for proper battery operation.

7.10.1 WPU/DCU 9064 (+14.4 Vdc) Battery Test. Perform the 9064 monitor battery test for the WPU and DCU Assemblies as indicated below:

a. Ensure that the **AS201** is connected to the **3160** monitor and the monitor is turned OFF.

b. Remove the two (2) batteries from the DCU and/or WPU battery compartments (the batteries are interchangeable).

c. Press the "POWER LEVEL" button located on each battery (see Figure 7-7) and perform the indicated action:

(1) If all power level LED indicators are extinguished or the right-most LED flashes (voltage reading bad), replace the battery (see Page 7-15, paragraph 7.8.4). (Dispose of used battery pack(s) as specified in the "BATTERY PACK SERVICE PRECAUTIONS AND DISPOSAL" procedures located in the front of this manual.)

(2) If less than three (3) of the adjacent power level LED indicators on the battery are illuminated solid (voltage reading low), reinstall the battery in the DCU or WPU battery compartment, connect the **AS201** to the **3160** monitor (with the DCU securely seated into the retaining slot on the MRI pole for DCU battery charging) and allow the battery to recharge for a minimum of 8 hours.

(3) If three (3) or more of the adjacent power level LED indicators on the battery are illuminated solid (voltage reading good), reinstall the batteries in the DCU and/or WPU battery compartments.

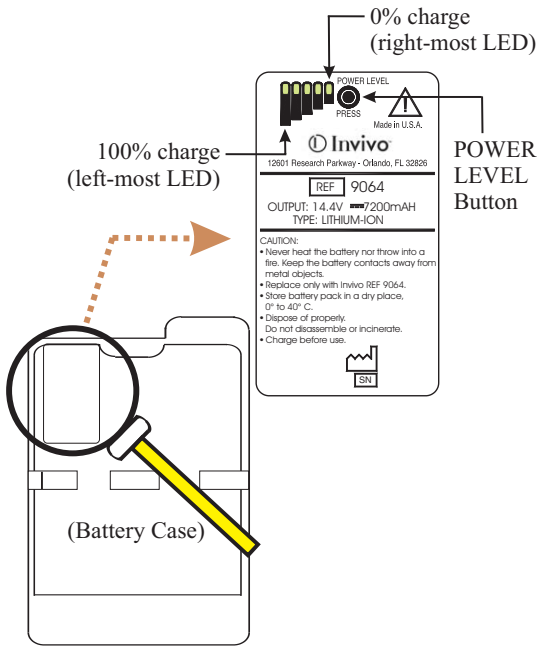


Figure 7-7. Sample 9064 Battery Label

7.10.2 WECG/WSPO2 9065 (4.1 Vdc) LI Battery Test. Perform the 9065 battery test for the WECG/SPO2 transmitter modules as indicated below:

a. Remove the batteries from the WECG and/or WSPO2 transmitter module battery compartments (the batteries are interchangeable).

b. Connect a DMM across the exposed battery terminals.

c. If the battery is dead (fully depleted), replace the battery (see Page 7-15, paragraph 7.8.5).

d. If the voltage measured is ≤ +3.3 Vdc (voltage reading low), recharge the battery in the Patient Module battery charger (Invivo Part Number 9023) for a minimum of 8 hours.

e. If the voltage measured is > +3.3 Vdc (voltage reading good), reinstall the batteries in the transmitter modules.

7.10.3 DCU HB16 (+3 Vdc) Battery Test. (See Appendix H: Figure H-2 for component location diagram) Perform the HB16 motherboard lithium battery test at the DCU as indicated below:

a. Perform steps on Page 7-13, paragraph 7.8.2(a) to remove the AS240 DCU Display Assembly.

b. On a workbench, remove the front panel assembly from the DCU (10 screws).

c. Remove the RF antenna wire from the front panel.

d. Connect a DMM across the HB16 battery (negative (-) lead to the AB160C motherboard mounting screw next to the battery, and a positive (+) lead to the top of the battery case).

e. If the voltage measured is ≤ +2.9 Vdc (voltage reading bad), replace the DCU (see Page 7-13, paragraph 7.8.2(a)).

f. If the voltage measured is > +2.9 Vdc (voltage reading good), reassemble the monitor as required.

7.11 Maintenance Drawings. The following paragraphs provide guidance on locating replacement parts and accessories for the **3160 Series MRI Physiological Monitor**.

7.11.1 Replacement Parts. General purpose replacement parts can be found by referencing the Spare Parts List in Section 10, as well as the Maintenance Drawings contained in Appendix J of this manual. These drawings are listed in the Drawing Index (see Table J-1) located at the beginning of the Appendix. Once the assembly of interest is located, turn to the indicated page number to examine the corresponding system level drawing and/or diagram. Parts lists are included in each assembly drawing. Subassemblies can then be cross-referenced by find numbers (i.e., "ITEM") or applicable reference designators ("REF. DES") listings both on the drawings and in the associated parts lists. The "USED ON" column in the Drawing Index designates to which specific model, option and/or equipment configuration each drawing applies.

7.11.2 Accessories. A complete list of accessories available for use with the **3160 Series MRI Physiological Monitor** is provided in the front of the **3160 Series MRI Physiological Monitor Operations Manual** (Invivo Part Number 9569).

SECTION 8
RADIO PROGRAMMING INSTRUCTIONS

8.0 RADIO PROGRAMMING INSTRUCTIONS.

NOTE

Contact Invivo Corporation's Technical Support staff (see Section 1: Page 1-6, paragraph 1.5) to acquire the latest programming command lines before attempting to reprogram the radio(s).

8.1 Introduction. The HE119 (Cirronet P/N WIT2450) radio transceivers can be programmed and/or reprogrammed to accommodate various communications setup configurations for the **3160** monitor's WPU and DCU units. This section provides setup information and specific instructions to program the radio transceivers for operation in the various system configurations. The WPU and DCU should be programmed separately to the radio parameters indicated for each unit in the following procedures.

8.2 Required Test Equipment. The following test equipment is required to program the HE119 radio transceivers for use in the **3160** monitors:

- **3160** monitor with HE119 radio transceivers installed
- IBM pc-compatible 101-key keyboard with standard connector (or Standard-to-PS2 cable adapter attached)
- IBM pc-compatible VGA/SVGA monitor (optional for DCU programming)

8.3 Setup. Perform the following steps to prepare the HE119 radio transceivers installed in the **3160** monitor's WPU and DCU for receiving programming instructions (see):

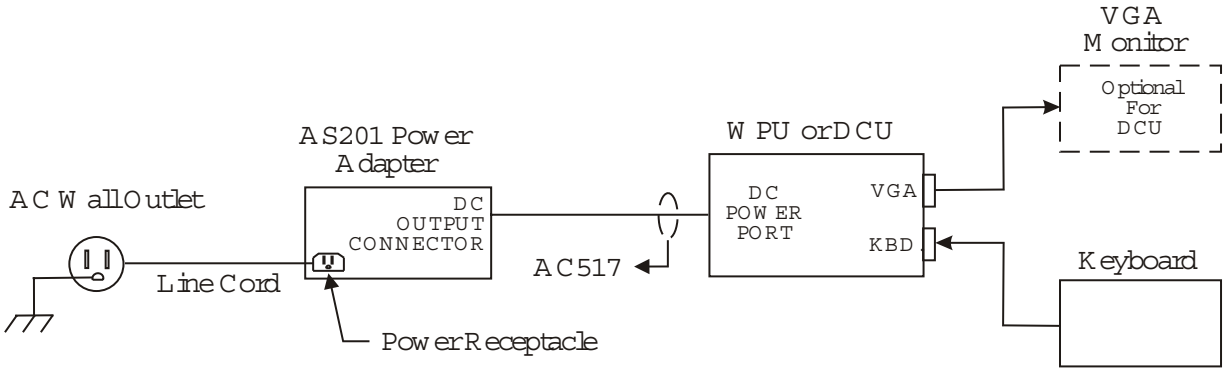


Figure 8-1. Radio Programming Setup

a. Detach the DCU from the MRI pole.

b. Attach the keyboard cable (and adapter cable if necessary) to the keyboard connector located on the unit to be programmed (WPU or DCU).

c. Attach the monitor cable to the video connector located on the unit (optional connection for DCU).

d. Connect the AS201 Power Adapter to the unit to be programmed.

NOTE

The HE61 RF antenna should be disconnected from the jack on the DCU rear panel, and power removed from the unit not being programmed, while performing the procedures in this section.

e. Turn ON the unit.

f. Type: **WIT**.

g. The radio configuration window is displayed on the screen. The following header information is displayed in the window:

F1-Help F10-Change Baud F11-Toggle Echo F12-Exit

h. If **28800 BAUD** is also displayed (new radio or radio pre programmed for 28.8Kbps baud rate), go to step "j"; if not, perform step "i".

i. Press the <F10> key until the above baud rate is displayed, then press <Enter> to select it.

j. Proceed to paragraph 8.4 below to program the HE119 transceivers for your system.

8.4 HE119 Programming for Single DCU Communications. Perform the following steps to program a base WPU unit for remote radio communications with a single DCU unit.

a. Enter radio parameter data into the HE119 transceiver's memory by performing the following steps. Each radio parameter is entered by typing a two-letter code and then the applicable value associated with that code. (For example, the two-letter code to set the radio's transceiver mode is "wb." To specify a transceiver mode value of 1 (base), the programmer should then type: **wb1** <Enter>.)

b. When the programmer types a radio parameter and presses <Enter>, the radio will automatically echo the value just entered on the next line on the computer screen. (To continue the above example, if the programmer types **wb1** <Enter>, the next line on the screen will display the following text: **1**.)

c. Enter all required *NETWORK COMMANDS* as follows:

Command	BASE (WPU)	REMOTE (DCU)	Description
wn [see notenotenotenotenote]	____ (Default=0)	____ (Default=0)	Set Network Number (0 thru 3f)
wb	1	0	Set Transceiver Mode (1=Base/0=Remote)
wd	3F	0	Set Default Handle (0 thru 3E; 3F=Broadcast Mode)
wg	0	0	Enable Global Network Mode (0=link to wn value/1=link to any pattern)
wl	0	0	Set Lockout Key
wu	0	0	Set Point-to-Point Direct Mode (0=Multipoint/1=Point-to-Point)
wp	1	1	Set Transmit Power (1=63mW/18dBm)

NOTE

The HE119 transceivers located in both the WPU and DCU must be set to the same Network Number (i.e., "wn" value) in order to communicate.

d. Enter all required *SERIAL INTERFACE COMMANDS* as follows:

Command	BASE (WPU)	REMOTE (DCU)	Description
sd	0F	0F	Set Data Rate (0F=28.8Kbps baud)
sp	12	0	Set Protocol Mode (12=Tx transparent/0=Point-to-Point transparent)

e. Enter all required *PROTOCOL COMMANDS* as follows:

Command	BASE (WPU)	REMOTE (DCU)	Description
ph	90	90	Set Hop Duration (33_{16}=6.712 msec)
pk	N/A	09	Set Minimum Packet Length
pn	04	N/A	Set Maximum Number of DCUs
pt	0	0	Set Packet Timeout Duration
pr	03	10	Set ARQ Attempt Limit
pv	0	0	Set Slot Assignment Mode (0=Dynamic/1=Static)
pw	1F	N/A	Set Base Slot Size (69.4µs/count or 4 bytes/count)
px	1	0	Set ARQ Mode (Enable Redundant Transmit) (0=disable/1=enable)
pe	1	1	Set Alternate Frequency Band

f. Enter all required *STATUS COMMANDS* as follows:

Command	BASE (WPU)	REMOTE (DCU)	Description
zb	0	0	Banner Display Disable (0=disable/1=enable)
zc	1	1	Set Escape Sequence (0=disable/1=enable)
zp	0	0	Set Modem Wakeup Duty Cycle (Duty Cycle=$1/2^n$; where n=argument)
zq	N/A	0	Low Power Acquisition (0=disable/1=enable)

g. When all parameter data is entered into the radio transceiver's memory, type **m>** <Enter> to save the encoded parameters.

h. Shutdown:

(1) Exit the programming mode by pressing the <F12> key.

(2) Turn the unit power OFF.

(3) Unplug the keyboard and/or monitor cable from the unit.

NOTE

The HE119 transceivers located in both the WPU and DCU must be set to the same Network Number (i.e., "wn" value) in order to communicate.

8.5 Changing the DCU HE119 Network Number. New radio transceivers are shipped by Invivo pre-programmed as indicated in this section. The DCU is marked with a Network Number Label (see Figure 8-2). The Network Number listed on the label corresponds to the factory pre-programmed value for the "wn" network command for the monitor's transceivers.

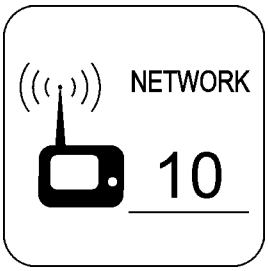


Figure 8-2. Sample Network Number Label

To facilitate equipment interchangeability, the NETWORK Number for the DCU HE119 transceiver can also be re-programmed to match the number used by the transceiver located in the WPU of a different 3160 monitor. To accomplish this, the "Network" option is selected from the SETUPS menu. Perform the following steps to change the Network Number for the DCU:

a. Press the **SETUP** Control Key.

b. Turn the Rotary Knob to highlight the **NETWORK** menu selection.

c. Press the Rotary Knob to select **NETWORK**.

d. Turn the Rotary Knob to highlight the desired Network Number selection (1-5).

e. Press the Rotary Knob to make the selection.

f. Press the **NORMAL SCREEN** Control Key.

g. Verify that the Network Number (see Figure 8-3) selected above is shown at the bottom of the display screen:

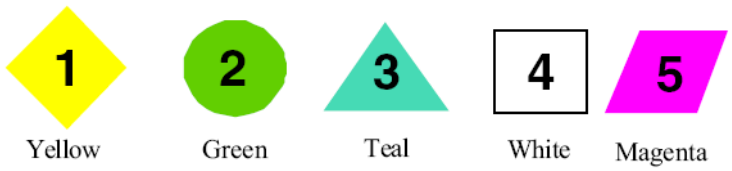


Figure 8-3. HE119 Network Numbers and Symbols

NOTE

The HE119 transceivers located in both the WPU and DCU must be set to the same Network Number (i.e., "wn" value in order to communicate.

8.6 Changing the WPU HE119 Network Number. New radio transceivers are shipped by Invivo pre-programmed as indicated in this section. The WPU is marked with a Network Number Label (see Figure 8-2). The NETWORK Number listed on the label corresponds to the factory pre-programmed value for the "wn" network command for the monitor's transceivers.

To facilitate equipment interchangeability, the Network Number for the WPU HE119 transceiver can be re-programmed to match the number used by the transceiver located in the DCU of a different **3160** monitor. To accomplish this, the "Network" option is selected from the "SETUPS" menu. Perform the following steps to change the Network Number for the WPU:

a. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).

b. Type: nav.

c. Press the <F4> key.

d. Press the <Down Arrow> key until the **NETWORK** menu selection is highlighted.

e. Press the <Enter> key to select **NETWORK**.

f. Press the <Down Arrow> key until the desired Network Number selection (**1-5**) selection is highlighted.

g. Press the <Enter> key to make the selection.

h. Press the <Esc> key to exit to the **NORMAL SCREEN** display.

i. Verify that the Network Number (see Figure 8-3) selected above is shown at the bottom of the display screen.

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SECTION 9
TROUBLESHOOTING PROCEDURES

9.0 TROUBLESHOOTING PROCEDURES.

WARNING

Electrical shock hazard: Prior to removing any boxes, ensure that power to the monitor has been turned OFF, the AS201 AC power line cord is unplugged and the batteries have been removed from the unit(s) (WPU and/or DCU). Failure to comply can result in serious injury to personnel, and/or damage to the monitor's internal circuits.

WARNING

At various points in these troubleshooting procedures, the technician is directed to remove a fiber optic cable and either observe an exposed equipment jack or cable tip with power applied to confirm the presence of a red fiber optic beam. Care should be taken to ensure that this beam is either observed at an oblique angle to the eye, or that a distance of not less than 1 meter separates the jack or cable tip from the retina. Under NO circumstances is this beam to be directed at the eyes while being held in close proximity to the face.

9.1 Introduction. Table 9-1 contains basic troubleshooting procedures for common problems that may be observed while operating, or attempting to operate, the **3160** monitor in the field. Before performing any of the troubleshooting procedures located in this section, confirm that the reported fault is present. Do not troubleshoot the equipment if the malfunction cannot be duplicated on the bench.

9.2 Required Test Equipment. Refer to Section 7: Page 7-1, paragraph 7.2 for a complete list of required test equipment.

9.3 Troubleshooting Flow. (See Figure 9-1.) Perform the following maintenance steps to isolate a system fault to a defective box or disposable/consumable part.

a. Perform Section 7: Page 7-17, paragraph 7.9 to obtain maintenance access to the internal components of the **3160** monitor (the monitor should power up with the WPU running on **AS201** +18 Vdc output power and the DCU operating on 9064 +14 Vdc backup battery power).

b. Confirm that all system interconnect cables and hoses between the WPU, DCU and PCU are securely attached according to **3160** Interconnect Diagrams (located in Appendix J of this manual).

c. Verify that all accessory cables and hoses are securely attached to the PCU.

d. If any cables or hoses are loose or disconnected, securely reattach them to the equipment. Verify that the fault has been cleared; if not, proceed to step "e".

e. Locate the fault observed in the Fault Index.

f. Enter the troubleshooting table (Table 9-1) at the page specified in the index and perform the troubleshooting procedures prescribed for that fault in the sequence presented. (Reference can also be made to the applicable Functional Block Diagrams located in Appendix J for further guidance concerning the ECG, SPO2, NIBP and optional Agents, IBP, TEMP, RESP and EtCO2 Patient Parameter Faults.) Troubleshooting will normally continue until the technician is directed to replace the faulty hardware with a spare part.

g. Upon replacement of a defective part (see Section 10), perform the "System Test and Verification" for the applicable Replaced Part (see Section 7: Page 7-3, paragraph 7.4.1) before returning the monitor to normal operation.

9.4 Fault Index. A field service fault index (hardware failure indications) for the 3160 monitor is provided below for ease of reference:

NOTE

Clear all existing Power Off faults (if any) prior to troubleshooting any Power On faults.

Fault Index

FAILURE INDICATION **PAGE NUMBER**

Power Off Faults

AS201 Power Adapter Won't Power Up on Facility Line Power 9-4
WPU Won't Power Up on AS201 +18 Vdc Output Power 9-4
DCU Won't Power Up on AS201 +18 Vdc Output Power 9-5
WPU Won't Power Up on +14.4 Vdc Battery Power 9-5
DCU Won't Power Up on +14.4 Vdc Battery Power 9-5

Power On Faults

(DCU/WPU Faults)

DCU Powers Up But Has No Display 9-5
DCU Control Panel Not Working 9-5
DCU System "Crash" Alarm Occurs 9-6
DCU Sound System Not Working 9-6
DCU Not Keeping Accurate Time 9-6
WPU Won't Communicate with DCU 9-6

(Patient Parameter Faults)

ECG Parameter Failure/ Not Working 9-6
SPO2 Parameter Failure/ Not Working 9-8
NIBP Parameter Failure/Not Working 9-9
Agents Parameter (with EtCO2) Failure/Not Working 9-11
O2 Measurements Not Working 9-12
IBP Parameter Failure/Not Working 9-13
F.O. TEMP Parameter Failure/Not Working 9-14
RESP Parameter Failure/ Not Working 9-15
EtCO2 Parameter Failure/Not Working 9-16

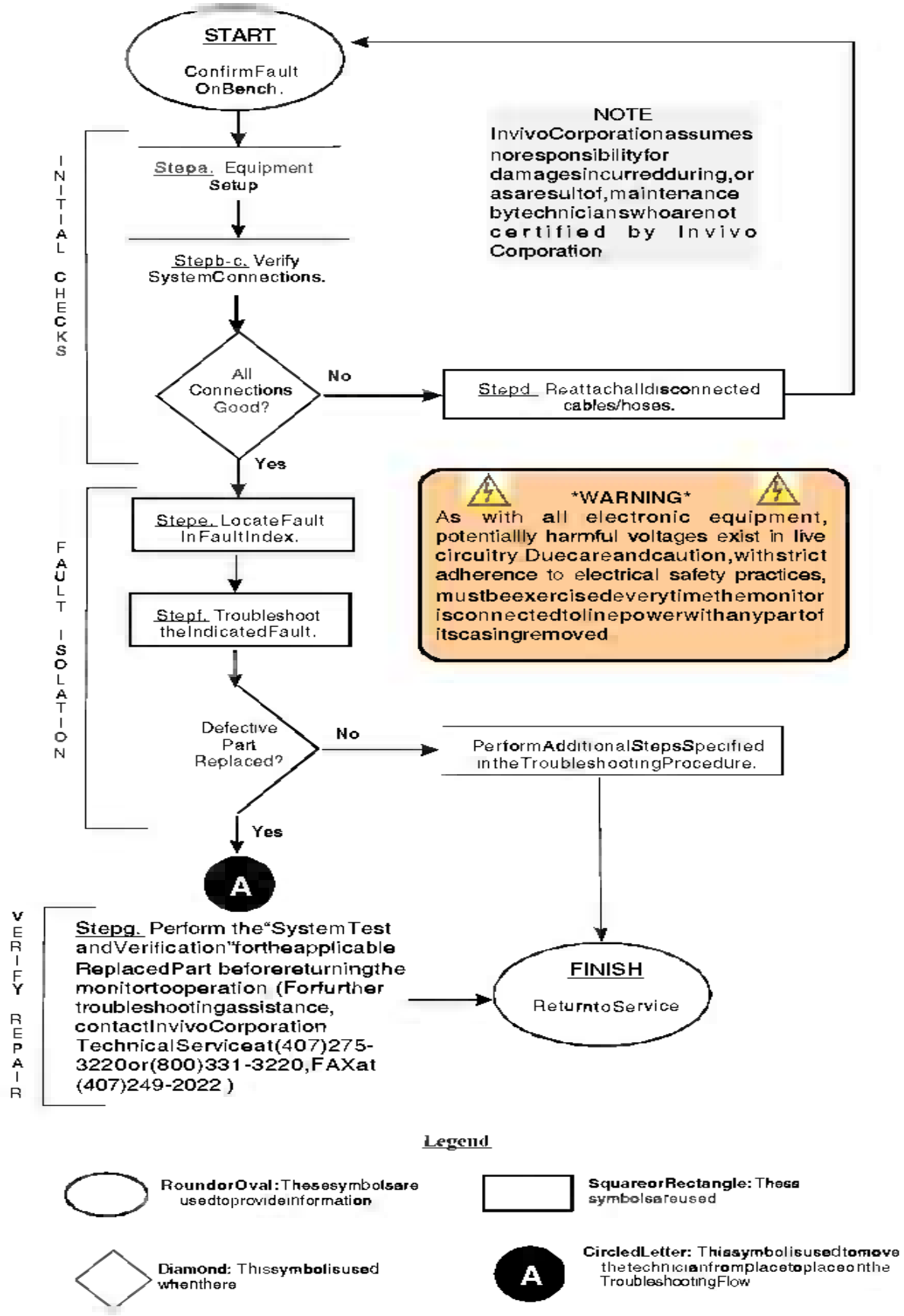
START
Confirm Fault On Bench.
NOTE
Invivo Corporation assumes no responsibility for damages incurred during, or as a result of, maintenance by technicians who are not certified by Invivo Corporation
INITIAL CHECKS
Step a. Equipment Setup
Step b-c. Verify System Connections.
All Connections Good?
No
Step d. Reattach all disconnected cables/hoses.
Yes
WARNING
As with all electronic equipment, potentially harmful voltages exist in live circuitry. Due care and caution, with strict adherence to electrical safety practices, must be exercised every time the monitor is connected to line power with any part of its casing removed
FAULT ISOLATION
Step e. Locate Fault In Fault Index.
Step f. Troubleshoot the Indicated Fault.
Defective Part Replaced?
No
Perform Additional Steps Specified in the Troubleshooting Procedure.
Yes
A
VERIFY REPAIR
Step g. Perform the "System Test and Verification" for the applicable Replaced Part before returning the monitor to operation (For further troubleshooting assistance, contact Invivo Corporation Technical Service at (407)275-3220 or (800)331-3220, FAX at (407)249-2022)
FINISH
Return to Service
Legend
Round or Oval: These symbols are used to provide information
Square or Rectangle: These symbols are used
Diamond: This symbol is used when there
Circled Letter: This symbol is used to move the technician from place to place on the Troubleshooting Flow

Figure 9-1. Main Troubleshooting Flow Diagram

Table 9-1. 3160 Monitor Field Troubleshooting Procedures

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
AS201 Power Adapter Won't Power Up on Facility Line Power	**WARNING** Shock hazard exists.	-	-	-
	a. Disconnect the AS201 line cord from the AC wall outlet and verify the presence of AS201 Power Adapter AC input power at the outlet.	Facility power is supplying continuous AC input power within tolerance (90 to 264VAC @ 47 to 63 Hz) to the AS201.	Troubleshoot facility power.	Reconnect the AS201 line cord to the AC outlet and proceed to action "b."
	b. Check the DC OUTPUT Indicator on the AS201.	The DC OUTPUT Indicator is illuminated green.	Disconnect the AS201 line cord from the AC wall outlet and proceed to action "c."	Contact Invivo Technical Service for further troubleshooting assistance.
	c. Using DMM, remove and check AS201 AC fuses.	Fuses both good.	Replace defective AS201 AC fuse(s).	Reconnect the AS201 line cord to the AC wall outlet, disconnect 3160 power cable AC517 from the AS201 and proceed to action
	d. Using DMM, check the output voltage across Pins 1 (+) and 2 (-) on the DC OUTPUT connector (see Appendix H: Figure H-5 for test point locations).	Observe a reading of +18.3 ±0.5 Vdc on the DMM.	Replace the AS201 Power Adapter.	Contact Invivo Technical Service for further troubleshooting assistance.
WPU Won't Power Up on AS201 +18 Vdc Output Power	a. Disconnect 3160 power cable AC517 from the WPU power port. Using DMM, check WPU DC fuse.	Fuse good.	Replace defective WPU DC fuse.	Replace the WPU Electronics Assembly.

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
DCU Won't Power Up on AS201 +18 Vdc Output Power	a. Ensure 3160 power cable AC517 is disconnected from the DCU power port. Using DMM, check DCU DC fuse.	Fuse good.	Replace defective DCU DC fuse.	Proceed to action "b."
	b. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Replace the DCU assembly (defective power switch).
WPU Won't Power Up on +14.4 Vdc Battery Power	a. Remove the WPU batteries.	-	-	-
	b. Perform a 9064 Battery test on both batteries (see Section 7: Page 7-18, paragraph 7.10.1).	At least three of the 9064 power level LED indicators are On (lit).	Replace defective or recharge depleted WPU batter(ies).	Proceed to Appendix G of this manual for further troubleshooting instructions.
DCU Won't Power Up on +14.4 Vdc Battery Power	a. Remove the DCU batteries.	-	-	-
	b. Perform a 9064 Battery test on both batteries (see Section 7: Page 7-18, paragraph 7.10.1).	At least three of the 9064 power level LED indicators are On (lit).	Replace defective or recharge depleted DCU batter(ies).	Proceed to Appendix G of this manual for further troubleshooting instructions.
DCU Powers Up But Has No Display	Replace the DCU Display Assembly.			
DCU Control Panel Not Working	Replace the DCU Display Assembly.			

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
DCU System "Crash" Alarm Occurs	Perform Section 7: Page 7-11, paragraph 7.6 to cold start the DCU.	The monitor boots up correctly and the "Normal Screen" is displayed.	Replace the DCU Display Assembly.	Return the monitor to operation.
DCU Sound System Not Working	On the DCU, ensure that CLICK TONE in the SOUND ADJUST, SETUPS Menu is ON, then press the NORMAL SCREEN control key.	An audible click tone is sounded by the DCU each time the control key is pressed.	Replace the DCU Display Assembly.	Return the monitor to operation.
DCU Not Keeping Accurate Time	Perform Time Set Verification on the DCU (see Section 5: Page 5-7, paragraph 5.4.6).	Time is recalibrated to the correct time and date.	Replace the DCU Display Assembly.	Return the monitor to operation.
WPU Won't Communicate with DCU	a. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).	-	-	-
	b. On the DCU and WPU, ensure that NETWORK in both SETUPS Menus is set to the same Network Number (1 to 5).	DCU and WPU Network Numbers match.	Change the DCU and/or WPU Network Number(s) to match (see Section 8: Page 8-4, paragraph 8.5 and Page 8-4, paragraph 8.6, respectively).	If symptoms persist, contact Invivo Technical Service for further troubleshooting assistance.
ECG Parameter Failure/ Not Working	a. Remove the WECG transmitter module battery.	-	-	-

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
ECG Parameter Failure/ Not Working (Cont'd)	b. Using DMM, check the WECG transmitter module +4.1 Vdc battery (observe polarity marked on battery).	The battery voltage measured is > +3.3 Vdc.	Fully recharge the WECG transmitter module battery or replace with a new battery.	Reinstall the battery and proceed to action "c."
	c. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Proceed to action "d."
	d. Check the communication status of the WECG transmitter module at the DCU.	The ECG status indicator at the bottom of the Normal Screen (see Section 2: Figure 2-2) is not displayed inside a red box with an "X" through it as pictured below:	Proceed to action "e."	Contact Invivo Technical Service for further troubleshooting assistance.
	e. Insert fully charged battery into the WSPO2 transmitter module.	-	-	-

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
ECG Parameter Failure/ Not Working (Cont'd)	f. Check the communication status of the SPO2 transmitter module at the DCU.	The SPO2 status indicator at the bottom of the Normal Screen (see Section 2: Figure 2-2) is not displayed inside a red box with an "X" through it as pictured below:	Replace the WPU Electronics Assembly.	Replace the WECG transmitter module.
SPO2 Parameter Failure/ Not Working	a. Remove the WSPO2 transmitter module battery.	-	-	-
	b. Using DMM, check the WSPO2 transmitter module +4.1 Vdc battery (observe polarity marked on battery).	The battery voltage measured is > +3.3 Vdc.	Fully recharge the WSPO2 transmitter module battery or replace with a new battery.	Reinstall the battery and proceed to action "c."
	c. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Proceed to action "d."

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
SPO2 Parameter Failure/ Not Working (Cont'd)	d. Check the communication status of the WSPO2 transmitter module at the DCU.	The WSPO2 status indicator at the bottom of the Normal Screen (see Section 2: Figure 2-2) is not displayed inside a red box with an "X" through it as pictured below:	Proceed to action "e."	Replace the WPU assembly.
	e. Insert a fully charged battery into the WECG transmitter module.	-	-	-
	f. Check the communication status of the ECG transmitter module at the DCU.	The ECG status indicator at the bottom of the Normal Screen (see Section 2: Figure 2-2) is not displayed inside a red box with an "X" through it as pictured below:	Replace the WPU Electronics Assembly.	Replace the WSPO2 transmitter module.
NIBP Parameter Failure/Not Working	a. Disconnect the NIBP adult cuff accessory from the NIBP (Inflate and Sense) ports on the PCU.	-	-	-

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
NIBP Parameter Failure/Not Working (Cont'd)	b. Press the NIBP START/ STOP key on the DCU control panel to initiate a manual NIBP reading.	A moderate stream of air exits the Inflate port. A flashing red "NOT INFLATING" error message is displayed in the DCU's NIBP icon.	Replace the WPU Electronics Assembly.	Proceed to action "c."
	c. Setup the WPU for operation in the Keyboard Navigation (Nav) mode (attach a monitor and keyboard as specified in Appendix E of this manual).	-	-	-
	d. On the WPU, access the NIBP CAL screen in the NIBP TESTS, SERVICE (BIO-MED) Menu.	-	-	-
	e. Verify correct NIBP Primary (Sense) transducer calibration.	NIBP CAL screen displays the following Pri(mary) values: OFFSET PRESS = 9 (±5) PRESS READING = 0 (±1)	Replace the WPU Electronics Assembly.	Proceed to action "f."
	f. Verify correct NIBP Secondary (Inflate) transducer calibration.	NIBP CAL screen displays the following Sec(ondary) values: OFFSET PRESS = 10 (±5) PRESS READING = 0 (±1)	Replace the WPU Electronics Assembly.	Proceed to action "g."

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
NIBP Parameter Failure/Not Working (Cont'd)	g. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Contact Invivo Technical Service for further troubleshooting assistance.
Agents Parameter (with EtCO2) Failure/Not Working	a. Disconnect the patient tubing from the GAS Input port on the water trap.	-	-	-
	b. Check the water trap for proper inlet air flow.	A mild air vacuum is detected at the GAS Input port.	Proceed to action "c."	Proceed to action "d."
	c. Check for full/occluded water trap.	The "CO2 OCCLUSION" message is not displayed in the top center of the DCU screen.	Replace the water trap.	Replace the WPU Electronics Assembly.
	d. Verify internal gas tubing is securely attached to the WPU Electronics Assembly side panel using 3160 interconnect diagram (see Appendix J).	Internal connections are good.	Connect gas sensor wires/ hoses as required and proceed to action "e."	Proceed to action "g."
	e. Check for normal Agent Bench operation.	Agent Bench is operating properly.	Proceed to action "f."	Return the monitor to operation.

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
	f. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Proceed to action "f."
	g. Perform Agents Adjustment Procedure (see Section 6: Page 6-3, paragraph 6.5.3).	-	-	-
	h. Perform Agents Verfication Procedure (see Section 5: Page 5-30, paragraph 5.6.7).	Verification checks are successful.	Replace the WPU Electronics Assembly.	Contact Invivo Technical Service for further troubleshooting assistance.
O2 Measurements Not Working	a. Ensure that the adapter cable is plugged into the jack on top of the Disposable Oxygen Sensor.	-	-	-
	b. Check for normal O2 Sensor operation.	O2 Sensor is operating properly.	Replace the Disposable Oxygen Sensor, then proceed to action "c." NOTE Refer to the **3160 Series MRI Physiological Monitor** Operations Manual (Invivo Part Number 9569) for applicable O2 Sensor Calibration Procedures.	Return the monitor to operation.
	c. Check for normal O2 Sensor operation.	O2 Sensor is operating properly.	Proceed to action "d."	Return the monitor to operation.

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
O2 Measurements Not Working (Cont'd)	d. Remove the Disposable Oxygen Sensor and check for waste gas exhaust exiting the filtered O2 sensor block on the WPU rear panel.	Air flow is detected. NOTE Air flow will be minimal.	Proceed to action "e."	Replace the WPU Electronics Assembly.
	e. Verify internal connections to O2 sensor block and Oxygen Sensor using WPU interconnect diagram (see Appendix J).	Internal connections are good.	Connect O2 sensor wires/ hoses as required and proceed to action "f."	Replace the WPU Electronics Assembly.
	f. Check for normal O2 Sensor operation.	O2 Sensor is operating properly.	Replace the WPU Electronics Assembly.	Return the monitor to operation.
IBP Parameter Failure/Not Working	a. Connect the active output of a Pressure Simulator to the P1/D1 connector on the PCU.	-	-	-
	b. Disconnect cable AC564 from the PCU/DCU (DB15) connector on the WPU right rear panel.	-	-	-

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
	c. Using DMM, check the WPU IBP output voltage to the PCU. Attach the positive (+) lead to the WPU right rear panel PCU/DCU connector Pin 3, and negative (-) lead to Pin 4 (see Appendix H: Figure H-1 for test point locations).	Observe a reading of +12 ±0.5 Vdc on the DMM.	Replace the WPU Electronics Assembly.	Reconnect AC564 to the WPU and proceed to action "d."
	d. Disconnect the IBP F.O. cable from the IBP port on the WPU right rear panel (see Appendix H: Figure H-1 for component location).	-	-	-
	e. Confirm presence of fiber optic beam.	Exposed tip of cable is illuminated red.	Replace PCU assembly (defective AS226 IBP assembly).	Proceed to action "f."
	f. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU Display Assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Contact Invivo Technical Service for further troubleshooting assistance.
F.O. TEMP Parameter Failure/ Not Working	a. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Replace the WPU Electronics Assembly (defective HE113 module).

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
RESP Parameter Failure/ Not Working	a. Remove the WSPO2 transmitter module battery.	-	-	-
	b. Using DMM, check the WSPO2 transmitter module +4.1 Vdc battery (observe polarity marked on battery).	The battery voltage measured is > +3.3 Vdc.	Fully recharge the WSPO2 transmitter module battery or replace with a new battery.	Reinstall the battery and proceed to action "c."
	c. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Proceed to action "d."
	d. Check the communication status of the WSPO2 transmitter module at the DCU.	The WSPO2 status indicator at the bottom of the Normal Screen (see Section 2: Figure 2-2) is not displayed inside a red box with an "X" through it as pictured below: 	Proceed to action "e."	Contact Invivo Technical Service for further troubleshooting assistance.
	e. Insert a fully charged battery into the WECG transmitter module.	-	-	-

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
RESP Parameter Failure/ Not Working (Cont'd)	f. Check the communication status of the ECG transmitter module at the DCU.	The ECG status indicator at the bottom of the Normal Screen (see Section 2: Figure 2-2) is not displayed inside a red box with an "X" through it as pictured below:	Replace the WPU Electronics Assembly.	Replace the WSPO2 transmitter module.
EtCO2 Parameter Failure/Not Working	a. Disconnect the patient tubing from the GAS Input port on the water trap.	-	-	-
	b. Check the water trap for proper inlet air flow.	A miled air vacuum is detected at the GAS Input port.	Proceed to action "c."	Proceed to action "d."
	c. Check for full/occluded water trap.	The "CO2 OCCLUSION" message is not displayed in the top center of the DCU screen.	Replace the water trap.	Replace the WPU Electronics Assembly.
	d. Verify internal gas tubing is securely attached to the WPU Electronics Assembly side panel using 3160 interconnect diagram (see Appendix J).	Internal connections are good.	Connect gas sensor tubes as required and proceed to action "e."	Proceed to action "g."
	e. Check for normal EtCO2 Bench operation.	EtCO2 Bench is operating properly.	Proceed to action "f."	Return the monitor to operation.

Table 9-1. 3160 Monitor Field Troubleshooting Procedures (Continued)

Symptom	Action	Normal Indication	If Indication Is Abnormal	If Indication Is Normal
EtCO2 Parameter Failure/Not Working (Cont'd)	f. Check the status of the Error Code Display on the DCU AB213 Power Board (see Appendix H: Figure H-6 for component locations).	Left decimal is On (lit) solid green, right decimal is flashing green and all numeric segments are Off (extinguished).	Blank Display: Replace the DCU Display Assembly. Error Code Displayed: Proceed to Appendix G of this manual for further troubleshooting instructions.	Proceed to action "g."
	g. Perform EtCO2 Adjustment Procedure (see Section 6: Page 6-1, paragraph 6.5.2).	-	-	-
	h. Perform EtCO2 Verification Procedure (see Section 5: Page 5-29, paragraph 5.6.6).	Verification checks are successful.	Replace the WPU Electronics Assembly.	Contact Invivo Technical Service for further troubleshooting assistance.

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SECTION 10
SPARE PARTS LIST

10.0 SPARE PARTS LIST.

This section provides a list of field replaceable spare parts. Parts are categorized by Major Assembly and Disposable/Consumable parts.

Table 10-1. 3160 Monitor Field Replaceable Spare Parts List

Invivo Part Number	Description
Major Assemblies	
9023	WECG/SPO2 Patient Module 3.7V Battery Charger
9024	WPU/DCU 14.4V Battery Charger
9311	WSPO2 Transmitter Module
9312	WECG Transmitter Module
AS201	Power Adapter
AS215	WPU Electronics Assembly
AS219	PCU Assembly[1]
AS239	WPU Base Assembly[2]
AS240	DCU Display Assembly
Disposable/Consumable Parts	
9064	WPU/DCU 14.4V Lithium Ion Battery
9065	WECG/WSPO2 Patient Module 4.1V LI Batteries
9445	Disposable Anesthetic Oxygen Sensor (Agent Option Only)
9010F	Calibration Gas Canister, CO2 (EtCO2 Option Only)
9034A	Check Gas Canister, Desflurane (Agent Option Only)
9034B	Check Gas Canister, Enflurane (Agent Option Only)
9034C	Check Gas Canister, Sevoflurane (Agent Option Only)
9034D	Check Gas Canister, Isoflurane (Agent Option Only)
9034E	Check Gas Canister, Halothane (Agent Option Only)
94006A	Span Cal Gas Kit, Carbon Dioxide (Agent Option Only)
94006B	Span Cal Gas Kit, Nitrous Oxide (Agent Option Only)
94006C	Span Cal Gas Kit, Desflurane (Agent Option Only)
94006D	Span Cal Gas Kit, Sevoflurane (Agent Option Only)
94006E	Span Cal Gas Kit, Isoflurane (Agent Option Only)
94006F	Span Cal Gas Kit, Halothane (Agent Option Only)
94006G	Span Cal Gas Kit, Enflurane (Agent Option Only)
FU12	AS201 1.5A 250V Fuse
FU39	WPU/DCU 5A, 32V Fuse

Table 10-1. 3160 Monitor Field Replaceable Spare Parts List (Continued)

Invivo Part Number	Description
H165	Front Panel EMI Gasket
HM92E3	3160 Water Trap (Gas Option Only)

FOOTNOTES:

[1]The AS219 PCU Assembly also include the pole mount bracket, connector panel and front/rear covers with mounting hardware, as well as the AS226 IBP Assembly when the IBP option is installed (see Appendix H: Figure H-4 for component locations).

[2]The AS239 WPUT Base Assembly includes the AS215 WPUT Electronics Assembly, AS219 PCU Assembly, WPU base, casters, MRI pole and WPU battery compartment (replacement batteries ordered separately).

NOTE

A complete list of accessories available for use with the **3160 Series MRI Physiological Monitor** in the clinical environment is provided in the front of the **3160 Series MRI Physiological Monitor** Operations Manual (Invivo Part Number 9569).

APPENDIX A
LIST OF SYMBOLS

A.0 LIST OF SYMBOLS.

The following is a list of symbols for the **3160** monitor.

	Attention, Consult Accompanying Documents		Defibrillator-proof Type CF Equipment (IEC 60601-1) Protection Against Shock		1 (Rotate Counter-clockwise to Open) 0 (Rotate Clockwise to Close)
GAS	Patient Gas Input		Defibrillator-proof Type BF Equipment (IEC 60601-1) Protection Against Shock		Locked
I	ON (Main Power)		Type CF Applied Part		Unlocked
O	OFF (Main Power)		Alarms ON	LATEX	Latex-free Materials Are Used
	"ON" (For Part of the Equipment)		Alarms Silenced		Direct Current
	"OFF" (For Part of the Equipment		Heart Beat Detected		Weight
~	Alternating Current		Breathing Effort Detected		Dangerous Voltage
	Class II Equipment	MR	Not MRI Compatible		Patient
	Up/Increment	$\%SpO_2$	Percent Oxygen Pulse Saturation		Communication is Not Linked
	Down/Decrement		Earth (Ground)		Communication is Linked
	Input/ Output		Fuse	2X	Replace Fuses as Marked
SN	Product Serial Number	REF	Product Part Number	IPX7	Watertight Equipment
	Attention! Consult Accompanying Documents		Danger! High Voltage	ATTENTION	Attention: Electrostatic Safety Device Observe Precautions
	Date of Manufacture		Antenna		Equipotentiality		Do Not Adjust Without Referring to Service Manual
	Dispose of in accordance with your country's requirements	CE 0413	Indicates that the device conforms to the Medical Device Directive		Single Patient Use Only Do Not Reuse
	Non-ionizing Radiation	MR	MR Conditional		Battery		End-Tidal CO2 / O2 / Anesthetic Agents Output
	Danger! Possible Explosion Hazard		Do Not Use in the Presence of Flammable Anesthetics		End-Tidal CO2 / O2 / Anesthetic Agents Input
3155A 1000 G	3155A 1000 G	Do Not Bring Within 1000 Gauss Line			No European harmonized standard exists for the transmission frequencies used for medical telemetry. Potential restrictions may apply within one or more European (EU) member states.

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APPENDIX B
REPAIR

B.0 REPAIR.

All repairs on products under warranty must be performed by Invivo personnel, or an authorized Invivo Service and Repair Center. Unauthorized repairs will void the warranty (see Appendix C for specific warranty information).

If a monitor fails to function properly or requires maintenance beyond the scope of the troubleshooting procedures contained in Section 9 of this manual, contact Invivo Technical Service (see Section 1: Page 1-6, paragraph 1.5). Invivo Technical Service will advise you of the corrective action(s) required. If you are advised to return the monitor or any portion of it to Invivo for repair, please do the following:

1. Obtain a Return Authorization Number. This will ensure proper routing and facilitate timely repair of your monitor.
2. Remove batteries and package the monitor with adequate protection. If available, use the original carton and packing materials in which the monitor was shipped from Invivo.
3. Include a brief description of the problem as well as the name, address and phone number of the person to be contacted for additional information.
4. Provide a purchase order via FAX to Invivo Technical Service if your monitor is out of warranty; Invivo Technical Service can advise you of your monitor's warranty status, if need be. Repairs will be made at Invivo's current flat rate charge.
5. Ship the monitor, transportation prepaid, to the location specified by your Invivo Technical Service Representative with the Return Authorization Number written on the outside of the shipping carton. Repairs will be made, normally, within two weeks, and the monitor will be returned to you via prepaid ground delivery. If premium freight is required for warranty repairs, Invivo Technical Service will inform you of the additional shipping charges. For out of warranty repairs, all shipping charges are prepaid by the customer.

   Technical Service Department
   Invivo Corp.
   12501 Research Parkway
   Orlando, FL 32826

To ensure full reliability, it is recommended that all repairs be made by an Invivo Authorized Service and Repair center. For repair at your facility, a competent individual experienced in the repair of monitors can repair the monitor if it is authorized by Invivo Technical Service prior to the repair.

To order replacement parts, contact Invivo's Technical Service Department (see Section 1: Page 1-6, paragraph 1.5) for the latest information on parts pricing and availability.

When placing orders for new or replacement parts, Customer Service may request additional information about the monitor or its defective component(s). Serialized identification labels are located on the WPU and DCU (see Figure B-2), and also on each internal circuit board and subassembly (see Figure B-2).

Please ensure that the information on the identification labels for the monitor and the internal part(s) you with to order is readily available before contacting Customer Service.

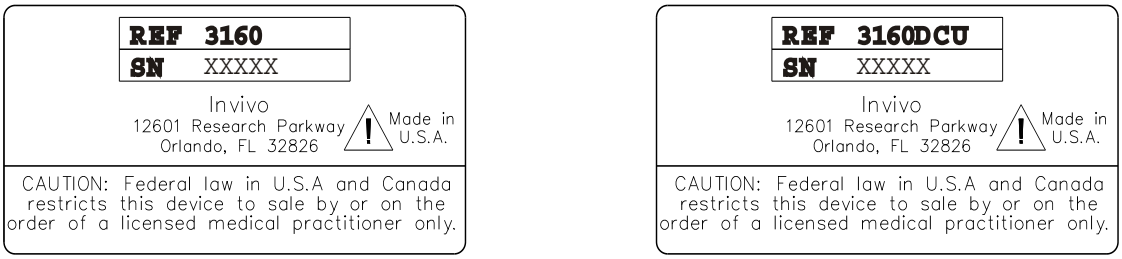
REF 3160
SN XXXXX
Invivo
12601 Research Parkway
Orlando, FL 32826
Made in U.S.A.
CAUTION: Federal law in U.S.A and Canada restricts this device to sale by or on the order of a licensed medical practitioner only.
(WPU ID Label)
REF 3160DCU
SN XXXXX
Invivo
12601 Research Parkway
Orlando, FL 32826
Made in U.S.A.
CAUTION: Federal law in U.S.A and Canada restricts this device to sale by or on the order of a licensed medical practitioner only.
(DCU ID Label)

Figure B-1. Sample 3160 Monitor ID Labels

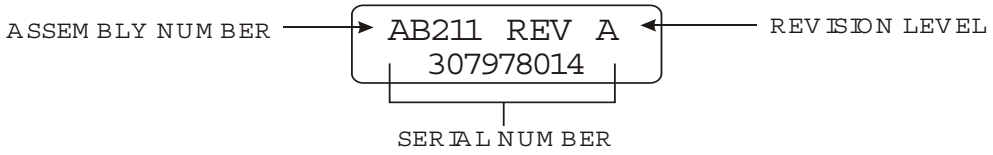

Figure B-2. Sample Assembly/Subassembly Label

CAUTION

No repair should ever be undertaken or attempted by anyone not having a thorough knowledge of the repair of Invivo monitors. Only replace damaged parts with components manufactured or sold by Invivo. Contact the Invivo Technical Service and Repair Center (see Section 1: Page 1-6, paragraph 1.5) for service and technical assistance.

APPENDIX C
WARRANTY

C.0 WARRANTY.

INVIVO CORPORATION warrants this product, other than its expendable parts, to be free from defects in materials and workmanship for a period of twelve (12) months from the date of original delivery to the buyer or to buyer's order, provided that same is properly operated under conditions of normal use, and that preventive maintenance and service is performed. This same warranty is made for a period of thirty (30) days on expendable parts. This warranty shall become null and void if the product has been repaired other than by Invivo, or if the product has been subject to misuse, accident, negligence or abuse.

Invivo's sole obligation under this warranty is limited to repairing a product which has been reported to Invivo's Technical Service Center during normal business hours (see Section 1: Page 1-6, paragraph 1.5) and shipped transportation prepaid. Invivo shall not be liable for any damages including but not limited to incidental damages, consequential damages or special damages.

This warranty is in lieu of any other warranties, guarantees or conditions, including merchantability or fitness for a particular purpose. The remedies under this warranty are exclusive and Invivo neither assumes nor authorizes anyone to assume for it any other obligation in connection with the sale or repair of its products.

CAUTION

Invivo Corporation does not recommend disassembly of the AS215 Electronics Assembly for purposes of troubleshooting/testing its internal components in the field. Invivo Corporation assumes no liability for loss of integrity to the AS215 assembly's RF seal once the seal is compromised, or for any damage to internal parts that may be caused by attempting circuit board field repair inside the unit.

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APPENDIX D
PRODUCT SPECIFICATIONS

D.0 PRODUCT SPECIFICATIONS.

GENERAL	
PATIENT SAFETY	
Designed to meet the requirements of CSA 22.2 and UL 60601-1.	
Defibrillator protection up to 5 KV.	
AS201 POWER REQUIREMENTS (AC Input)	
Input Voltages/Frequencies	86-265 VAC, 47/63 Hz
Output Voltage	18.3 Vdc, 3.6 A
Power Consumption, Maximum	< 100 Watts
AC Fuses: HE98	2 - 1.5A, 250 V Slow Blow - Invivo Part Number FU12
WPU/DCU BATTERY OPERATION (DC Input)	
Battery Type	Rechargeable Lithium Ion (9064)
Battery Voltage	14.4 Vdc
Operation Time	At least eight (8) hours
Battery Charge Time	Charged to 85% capacity within 8 hours
Battery Life	Minimum 80 Charge/Discharge Cycles
DC Fuse: WPU/DCU Rear Panels	5A, 32 V Slow Blow - Invivo Part Number FU39
ENVIRONMENT	
Operating Temperature	10 to 44° C (50 to 110° F)
Storage Temperature	-17 to +51° C (0 to 125° F)
Relative Humidity	0 to 80%, non-condensing
DIMENSIONS	
Height	**WPU:** 6.5 inches (16.5 cm) for the roll around design, 6 inches (15.2 cm) for the table mount design **PCU:** 5 inches (12.7 cm) **DCU:** 12 inches (30.5 cm)
Width	**WPU:** 16.3 inches (41.4 cm) **PCU:** 8.7 inches (22.1 cm) **DCU:** 15.9 inches (40 cm)
Depth	**WPU:** 15.7 inches (39.9 cm) **PCU:** 3.85 inches (9.8 cm) **DCU:** 6.2 inches (15.75 cm)
Weight	**WPU:** 15 lbs (6.8 kg) **PCU:** 1.5 lbs (0.6804 kg) **DCU:** 17.7 lbs (8 kg)

DISPLAY	
Type	800 x 600 pixel color LCD
Screen Size	12 inch (30.5 cm) diagonal
Sweep Speed	25 or 50 mm/S gives 9.2 S or 4.6 S of display respectively. For respiration, a speed of .33, 1.56, 3.13, 6.25, 12.5 or 25 mm/S is used.
Waveform Display Mode	Fixed Trace, Moving Erase Bar
Waveform Display Height	≥ 21 mm
"Full-Screen" Display Height	≥ 84 mm
Display Bandwidth	33 Hz

RECORDER (HT18 Thermal Array Recorder)	
Chart Speed	25 or 50 mm/second
Paper Type and Size	Non-Grid Thermal Paper, 50 mm wide
Alphanumeric annotation of date, time delay, paper speed, scales, lead configuration, patient mode, NIBP (systolic, mean, diastolic), heart rate, respiration rate, Et, FiCO2, Agents Et, Agents Fi and SPO2	
Automatic activation on alarm with alarm parameter printed at the beginning of trace	

WECG/WSPO2 3.7V Battery Charger (9023)	
POWER REQUIREMENTS	
Input Voltage (to AC adapter)	Universal AC; 85 to 265VAC @ 47 to 63Hz
Input Power	40W without power factor correction
Grounding Connection	Hospital Grade (with earth ground)
Protection	Over/under voltage, reverse voltage, under current
DC Connector	24 Vdc power pack
ENVIRONMENT	
Location	Console Room (outside of MRI magnet room)
Operating Temperature	0 to 40° C (32 to 104° F)
CHARGING CHARACTERISTICS	
Battery Charge Time	8 hours maximum from fully discharged to fully charged
Battery Presence Detection	Microswitch; charging and LED indication start immediately upon detection
Battery Type	3.7V lithium ion, 0.64+ Amp-Hours

CHARGING CHARACTERISTICS - (Cont'd)	
Battery Charge Control	Constant current/constant voltage format, "wake-up" charge on fully discharged batteries, battery data communication verification
Dimensions (HxWxD): 3.23 inches (8.20cm) x 7.98 inches (20.27cm) x 5.54 inches (14.07cm)	

NOTE

Refer to the **3160 Series MRI Physiological Monitor Operations Manual** (Invivo Part Number 9569) for additional specifications regarding the various features/options related to this monitor.

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APPENDIX E
WPU KEYBOARD NAVIGATION FEATURE

E.0 WPU KEYBOARD NAVIGATION FEATURE.

Under normal operating conditions, the WPU requires no user input. For service related purposes, the user interface with the WPU is supported via a standard PC keyboard attached to the keyboard connector and a standard PC monitor connected to the VGA port of the WPU (see Figure E-1).

NOTE

The keyboard and VGA ports are located behind the WPU rear maintenance access door (see Section 3: Figure 3-4).

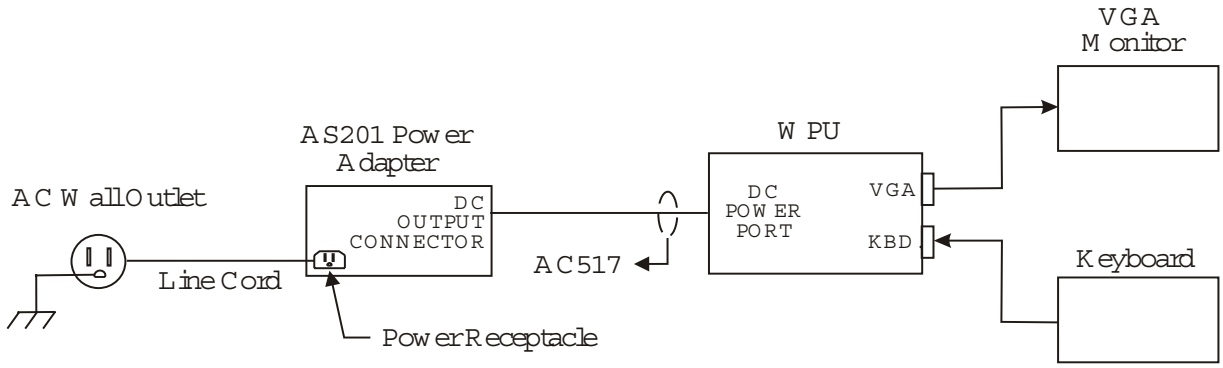


Figure E-1. Keyboard Navigation WPU Setup

The VGA monitor is intended solely for service use and not for patient monitoring. The DCU is used for all patient monitoring.

The keyboard, combined with the WPU software functionality, replaces the rotary knob and control keys. The keyboard navigation (Nav) feature is activated upon typing the lower case letters 'nav' in succession on the keyboard. Upon activation, the Nav feature displays a sign-on message and provides brief instructions for use. Full use instructions are provided by pressing the Backspace key.

The supported activation keys, and their respective commands, are as follows:

Table E-1. Nav(igation) Activation Keys

Activation Key	Command
Backspace	Keyboard Nav Help
End	Keyboard Nav Exit
Up Arrow	Knob Rotate Left
Left Arrow	Knob Rotate Left
Down Arrow	Knob Rotate Right
Right Arrow	Knob Rotate Right
Enter	Knob Press

Table E-1. Nav(igation) Activation Keys (Continued)

Activation Key	Command
F1	Freeze
F2	Event Mark
F3	Zero All
F4	Setup
F5	Alarms
F6	Recorder Setup
F7	NIBP Start / Stop
F8	Trends
F9	NIBP Interval
F10	Clear Trends
F11	NIBP STAT
F12	Record
Esc	Normal Screen
1	Help
2	Standby
3	Alarm Silence

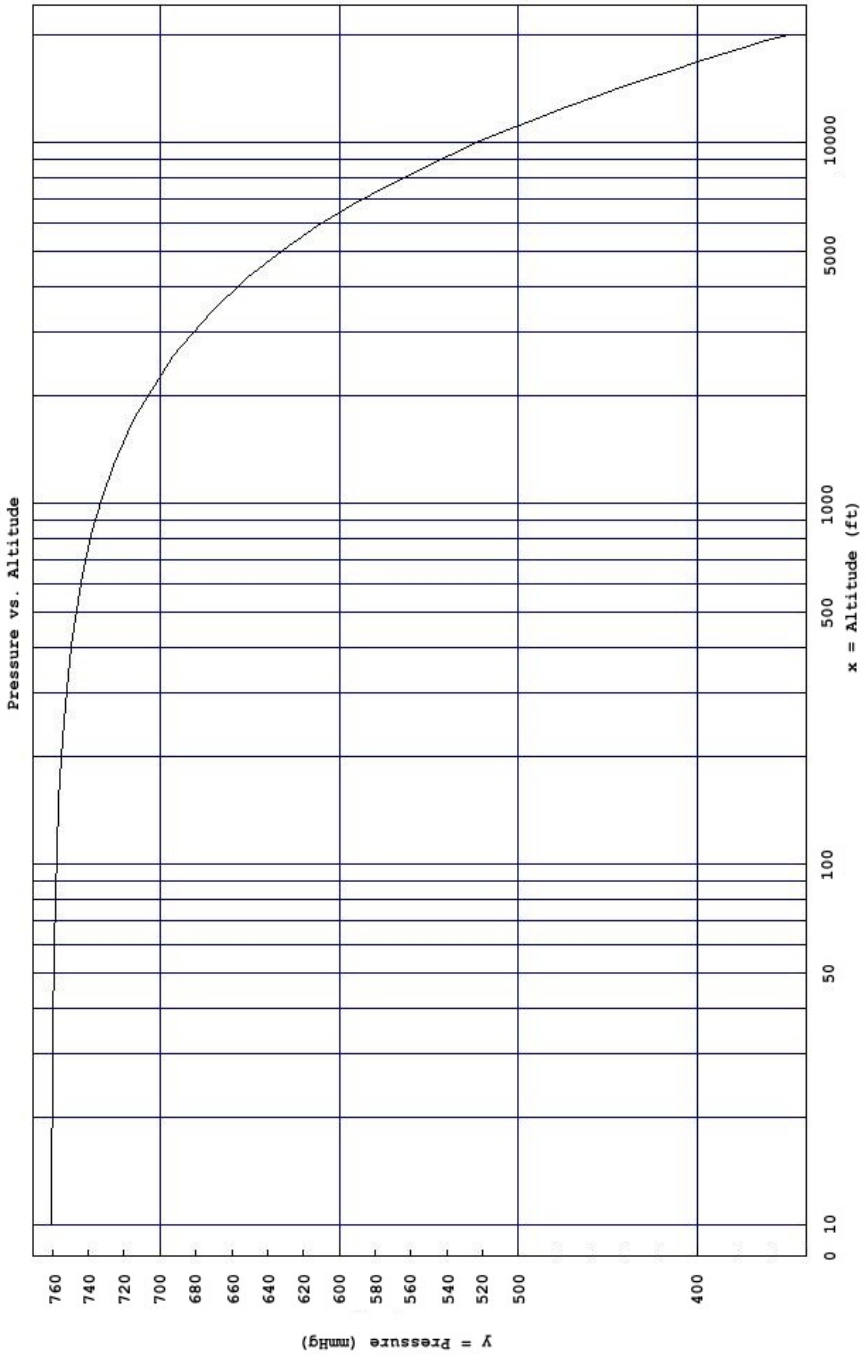
The WPU employs the same hierarchical menu system design as the DCU. Monitor control is accomplished via menus brought up by the attached keyboard. The menus have a 60 second time-out feature. If no action is taken during that time, the monitor automatically returns to the Normal Screen.

APPENDIX F
BAROMETRIC PRESSURE GRAPH

F.0 BAROMETRIC PRESSURE GRAPH.

The following graph plots the curve for barometric pressure as a function of altitude. Altitudes between sea level ($h = 0$) and 10,000 ft. ($h = 10{,}000$) elevation are shown on the "x"-axis with corresponding calculated values for barometric pressure $p(h)$ on the "y"-axis using the formula:

$$p(h) = 4.088 \times 10^{-12}(518.7 - 0.00356h)^{5.256}$$



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APPENDIX G
AB213 POWER BOARD ERROR CODES

G.0 AB213 POWER BOARD ERROR CODES.

WARNING

Electrical shock hazard: Prior to removing any boxes, ensure that power to the monitor has been turned OFF, the AS201 Power Adapter is unplugged and the batteries have been removed from the DCU. Failure to comply can result in serious injury to personnel, and/or damage to the monitor's internal circuits.

CAUTION

The **3160 Patient Monitors** contain Static Sensitive circuits. Proper handling procedures must be followed when touching any Printed Circuit Board (PCB) as static voltages usually present on clothing and personnel present great risk of damage to the circuits. **All Service Procedures *MUST* be performed by Properly Grounded Personnel at a Static-Free Work Station**.

G.1 Introduction. This appendix contains a list of AB213 Power Board malfunction error codes that may be observed while operating, or attempting to operate, the 3160 monitor. Before performing any of the troubleshooting procedures located in this section, confirm that the reported error code is present. Do not troubleshoot the equipment if the malfunction cannot be duplicated on the bench.

G.2 Troubleshooting Flow. (See Figure G-1.) Error codes are presented on two (2) adjacent 7-segment (plus two decimal points) LED Error Code Displays (U8 and U9) located on the DCU AB213 power board. Perform the following maintenance steps to access the fatal error code displayed on the AB213 board, correct the equipment malfunction and return the 3160 monitor to normal operation.

a. Ensure that the Power Switches on the PCU and DCU are set to the OFF ( ) position.

b. Remove the 9064 backup batteries from the WPU base.

c. Perform Section 7: Page 7-13, paragraph 7.8.2(a.) to remove the AS240 DCU Display Assembly.

d. On a workbench, remove the front panel assembly from the DCU (10 screws).

e. Connect the AS201 Power Adapter to the DCU and reinstall the 9064 backup batteries into the DCU rear battery compartments.

f. Set the Power Switch on the DCU to the ON ( ) position (the DCU powers up).

g. Read and record the error code located on the DCU AB213 board's Error Code Display (see Appendix H: Figure H-6 for component locations).

h. Enter Table G-1 and perform the Corrective Action(s) prescribed for that error code in the sequence presented.

i. Upon replacement of the defective hardware, perform the "System Test and Verification" for the applicable Replaced Part (see Section 7: Page 7-3, paragraph 7.4.1) before returning the monitor to normal operation.

G.3 AB213 Power Board Error Codes. A list of error codes (hardware failure indications) for the DCU AB213 power board is provided in numeric sequence in Table G-1.

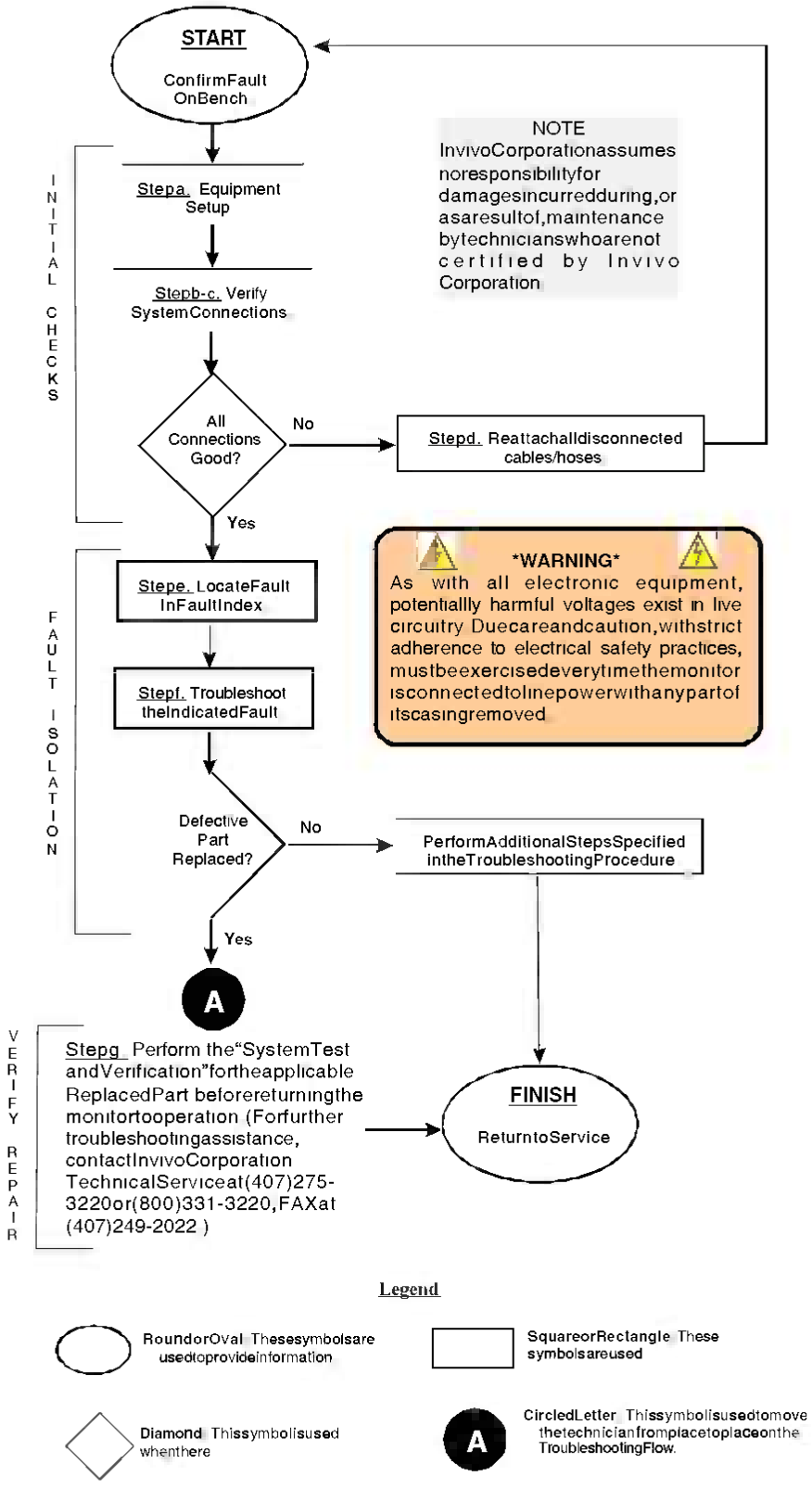

Figure G-1. AB213 Power Board Troubleshooting Flow Diagram

Table G-1. AB213 Power Board Error Codes

Error Code (Hex)	Title	Description	Corrective Action(s)
01	P3_3SuErC	+3.3 Vdc System Power Start-Up Error	Replace the DCU Display Assembly.
02	P3_3RunErC	+3.3 Vdc System Power Run Error	
03	P5VSuErC	+5 Vdc System Power Start-Up Error	
04	P5VRunErC	+5 Vdc System Power Run Error	
05	P12VSuErC	+12 Vdc System Power Start-Up Error	
06	P12VRunErC	+12 Vdc System Power Run Error	
07	R12VSuErC	Recorder Power Start-Up Error	Replace the DCU Display Assembly.
08	R12VRunErC	Recorder Power Run Error	
09	Pos5VLErC	Power Board 5VL to Processor 3.3VL	Replace the DCU Display Assembly.
11	SysKArunC	Motherboard Keep Alive Circuit Run Error	Replace the DCU Display Assembly.
12	SysKAstrtC	Motherboard Keep Alive Circuit Start Error	
13	MbComErC	Motherboard Communications Error	
14	MemErC	Power Board Memory Error	
15	ClkOscErC	Power Board Clock Oscillator Error	
16	LoRawVErC	9064 Battery Low Voltage Error	a. Remove the 9064 batteries from the DCU under test and ensure the AS201 power adapter is plugged into that unit.
			b. Cycle power to the unit.
			c. If the Error Code is still displayed, replace the DCU Display Assembly; if the Error Code is not displayed, proceed to action "d."
			d. Turn DCU power OFF and insert the batteries. Recharge the batteries for a minimum of 8 hours.
			e. Turn DCU power ON. If the Error Code is still displayed, replace the 9064 batteries.
17	RawCurErC	System Overcurrent Error	Troubleshoot the monitor power system for an overcurrent condition.

Table G-1. AB213 Power Board Error Codes (Continued)

Error Code (Hex)	Title	Description	Corrective Action(s)
18	DcInErC	Power Adapter Over/Under-Voltage Error	**WARNING** Shock hazard exists. a. Using DMM, verify presence of AS201 Power Adapter AC input power at wall outlet. b. Facility power is supplying continuous AC input power within tolerance (90 to 264VAC @ 47 to 63 Hz) to the AS201. c. If facility power is not present and within tolerance, troubleshoot facility power; otherwise, proceed to action "d." d. Replace the AS201 Power Adapter.
19	SwtchPwrErC	Power Board Switched Power Error	Replace the DCU Display Assembly.
31	NoStartErC	9064 Battery No Start Bit Error	Replace the 9064 batteries.
32	NoAckErC	9064 Battery No Acknowledge Bit Error	
34	NoStopErC	9064 Battery No Stop Bit Error	

APPENDIX H
COMPONENT LOCATION DIAGRAMS

H.0 COMPONENT LOCATION DIAGRAMS.

The following component location diagrams are provided as visual aids in calibrating, adjusting and troubleshooting the 3160 monitor. Test points, adjustable components, maintenance displays, status LEDs and jumpers are itemized as required.

H.1 Component Index. An index of the field service component location diagrams incuded in this Appendix is provided below for ease of reference:

Component Index

DIAGRAM **PAGE NUMBER**

Major Assemblies

Figure H-1. WPU (Right Rear View) - Component Location Diagram H-2
Figure H-2. DCU (Front Panel Assembly) - Component Location Diagram H-2
Figure H-3. DCU (Rear Panel Assembly) - Component Location Diagram H-3
Figure H-4. PCU (Exploded View) - Component Location Diagram H-3
Figure H-5. AS201 Power Adapter (Front View) - Component Location Diagram H-4

Subassemblies/Circuit Cards

Figure H-6. AB213 Power Board - Component Location Diagram H-4

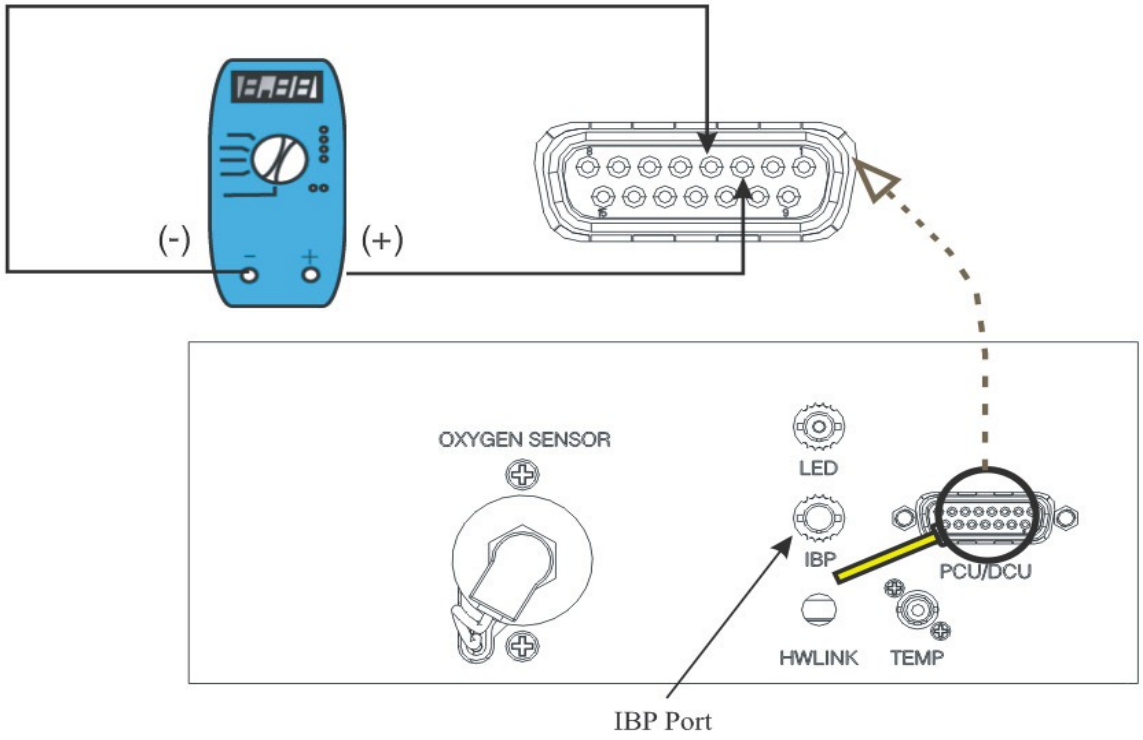

Figure H-1. WPU (Right Rear View) - Component Location Diagram

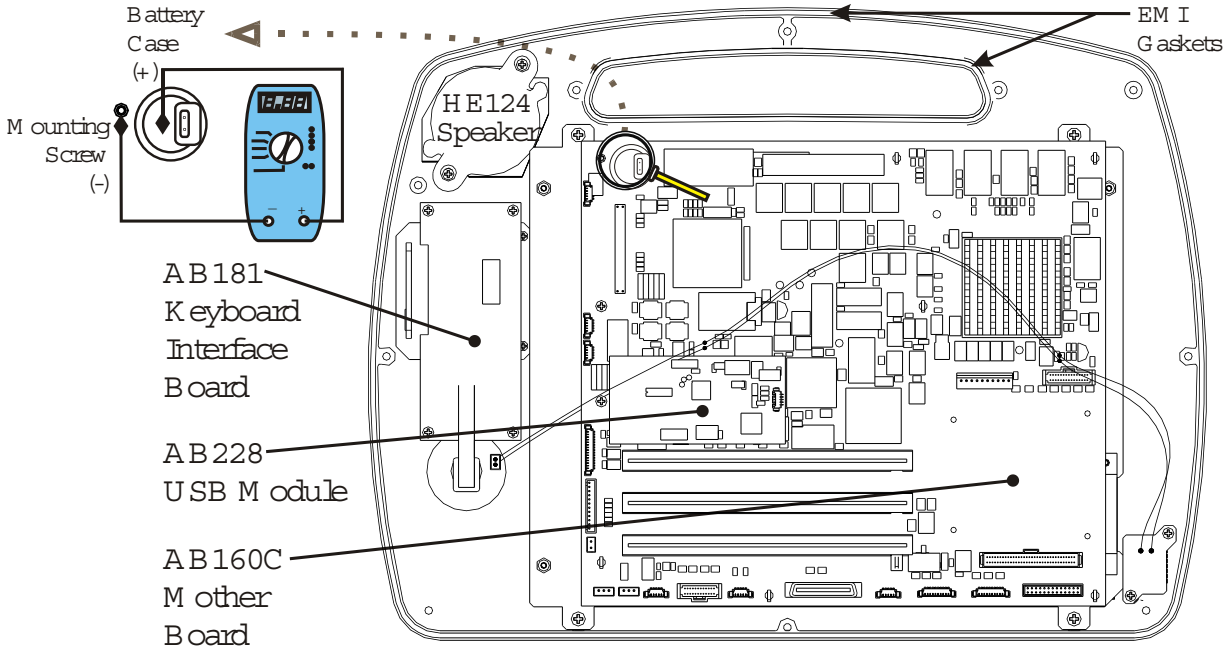

Figure H-2. DCU (Front Panel Assembly) - Component Location Diagram

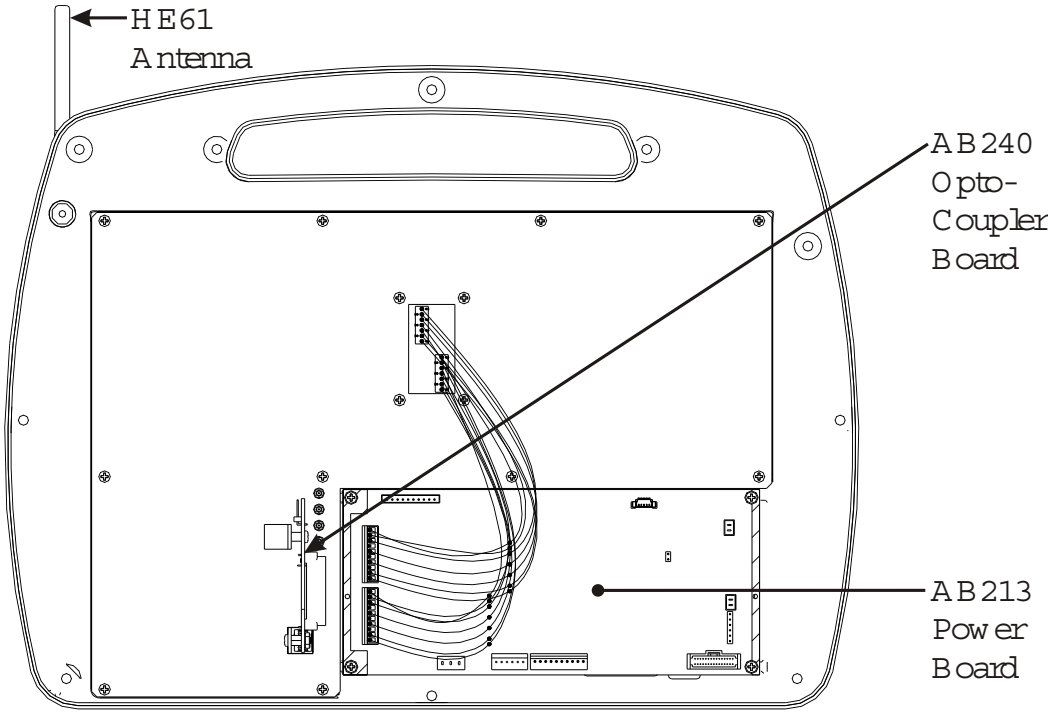

Figure H-3. DCU (Rear Panel Assembly) - Component Location Diagram

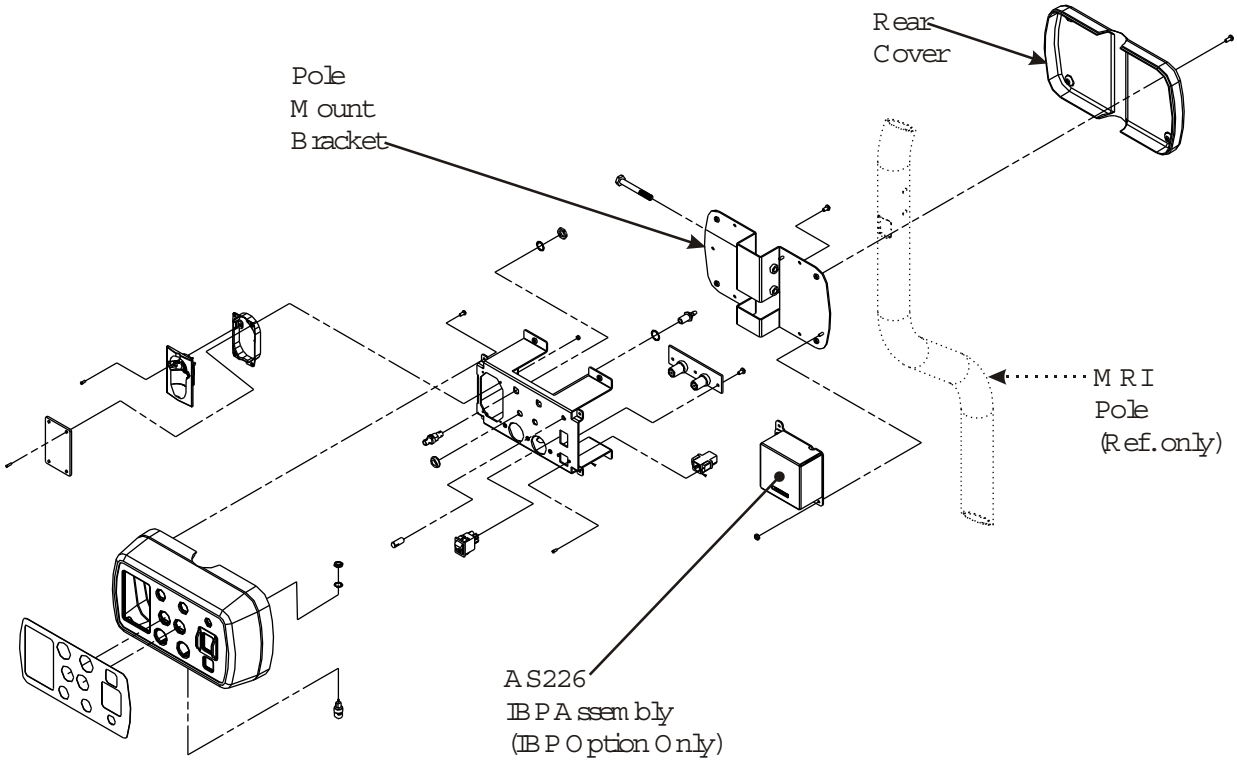

Figure H-4. PCU (Exploded View) - Component Location Diagram

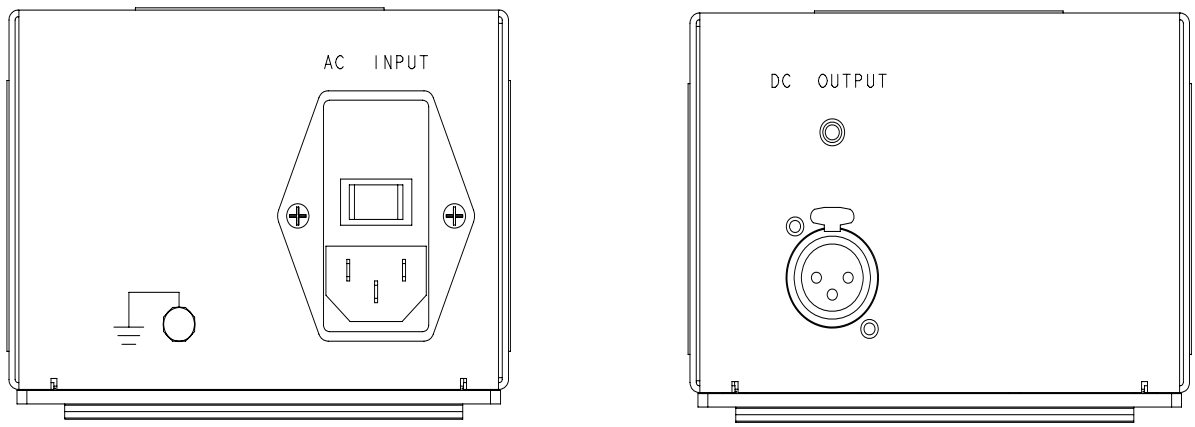

Figure H-5. AS201 Power Adapter (Front View) - Component Location Diagram

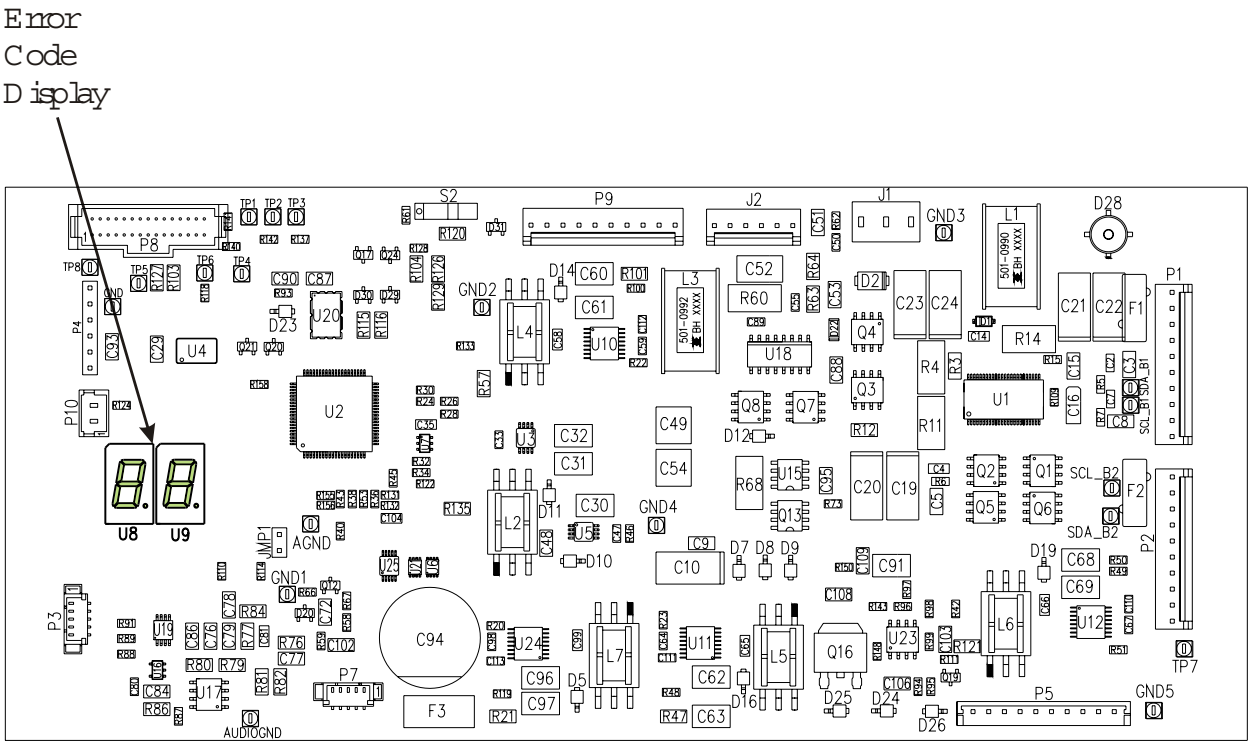

Figure H-6. AB213 Power Board - Component Location Diagram

APPENDIX I
PREVENTIVE MAINTENANCE CHART

I.0 PREVENTIVE MAINTENANCE CHART.

I.1 Introduction. Table I-1 is a preventive maintenance chart that can be used as an aid in performing routine preventive maintenance tasks (see Section 7) on the monitor. The maintenance technician may remove and/or photocopy the chart on the following page and use it to help schedule and keep track of these activities.

I.2 Instructions for Use. The header information (**MONITOR S/N, INSTALLATION DATE, 2____** (i.e., current service year)) should first be filled in by the technician. The "**Month⇒**" row at the top of the chart should be filled in next, with the first empty block corresponding to the month the monitor was installed at the hospital, clinic or medical facility. The first three letters of each month can be used to abbreviate the entries in this row (e.g., Jan, Feb, Mar, Apr...etc.).

Each maintenance "⇓**Task**" (referenced to Section 7: Page 7-2, paragraph 7.3 by applicable subparagraph number) may then be checked off and/or initialed to the right of the "X"-mark on the chart as it is successfully completed by the biotechnician(s).

NOTE

A separate preventive maintenance chart must be set up and maintained every service year for each monitor in use.

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MONITOR S/N: _____ **INSTALLATION DATE:** ____/____/____

Table I-1. 3160 Monitor Preventive Maintenance Chart

2____ ⇓ Task	Month ⇒																					
Paragraph 7.3.1	(Every 8 hours of use)																					
Paragraph 7.3.2											X										X	
Paragraph 7.3.3											X										X	
Paragraph 7.3.4																					X	
Paragraph 7.3.5																					X	
Paragraph 7.3.6																					X	
Paragraph 7.3.7																					X	

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APPENDIX J
MAINTENANCE DRAWINGS

J.0 MAINTENANCE DRAWINGS.

Maintenance significant System Level Diagrams and Major Assembly Drawings for field service repair of the 3160 monitor are provided as fold-out pages in this Appendix.

J.1 Drawing Index. The Maintenance Drawings are listed for ease of reference in the following Drawing Index (see Table J-1).

Table J-1. Drawing Index

Drawing #	Rev.	Used On	Assembly # - Drawing Title	Pg. #
System Level Diagrams				
190B102	**D**	3160	3160 - Physiological Monitor Interconnect Diagram	J-3
190B104	**E**	3160	AS215 - WPU Interconnect Diagram	J-4
190B106	**C**	3160	AS240 - DCU Interconnect Diagram	J-6
-	-	3160	ECG Parameter: Functional Block Diagram	J-7
-	-	3160	SPO2 Parameter: Functional Block Diagram	J-8
-	-	3160	NIBP Parameter: Functional Block Diagram	J-9
-	-	3160	EtCO2 Parameter: Functional Block Diagram	J-10
-	-	3160	Agents Parameter: Functional Block Diagram	J-11
-	-	3160	IBP Parameter: Functional Block Diagram	J-12
-	-	3160	TEMP Parameter: Functional Block Diagram	J-13
-	-	3160	RESP Parameter: Functional Block Diagram	J-14
Major Assembly Drawings				
197D729	**B**	3160	3160 - Assembly, MRI Physiological Monitor	J-15
195B197	**E**	3160	AS239 - Assembly, WPU Base	J-16
195B102	**C**	3160	AS215 - Assembly, WPU Electronics	J-20
195B106	**B**	3160	AS219 - Assembly, PCU	J-26
195B198	**E**	3160	AS240 - Assembly, DCU Display	J-27
197B701	**C**	3160	9311 - Assembly, Wireless SPO2 Module	J-32
197B702	**C**	3160	9312 - Assembly, Wireless ECG Module	J-33
195B063	**C**	AS201	AS201 - Assembly, Power Adapter	J-34

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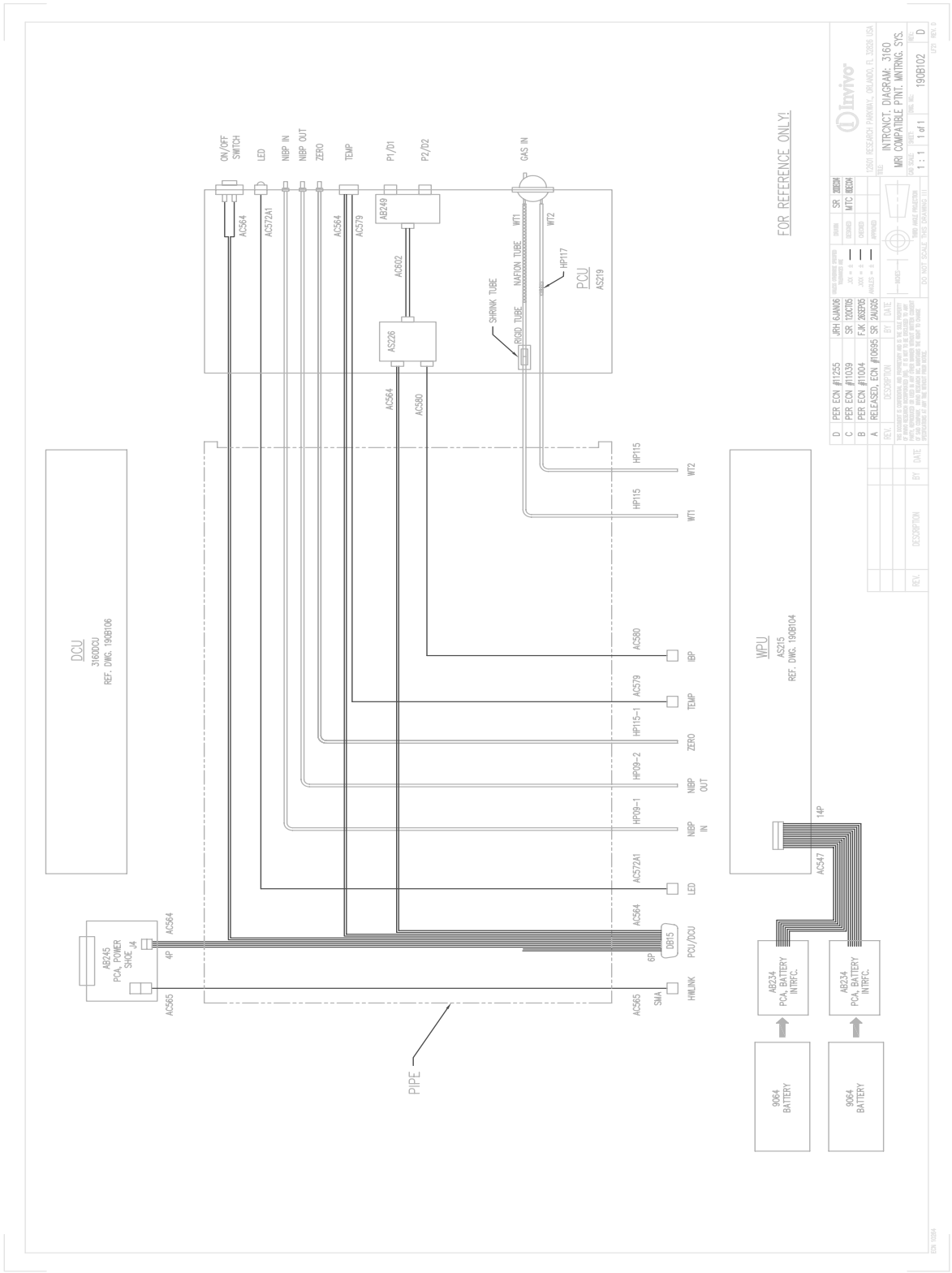
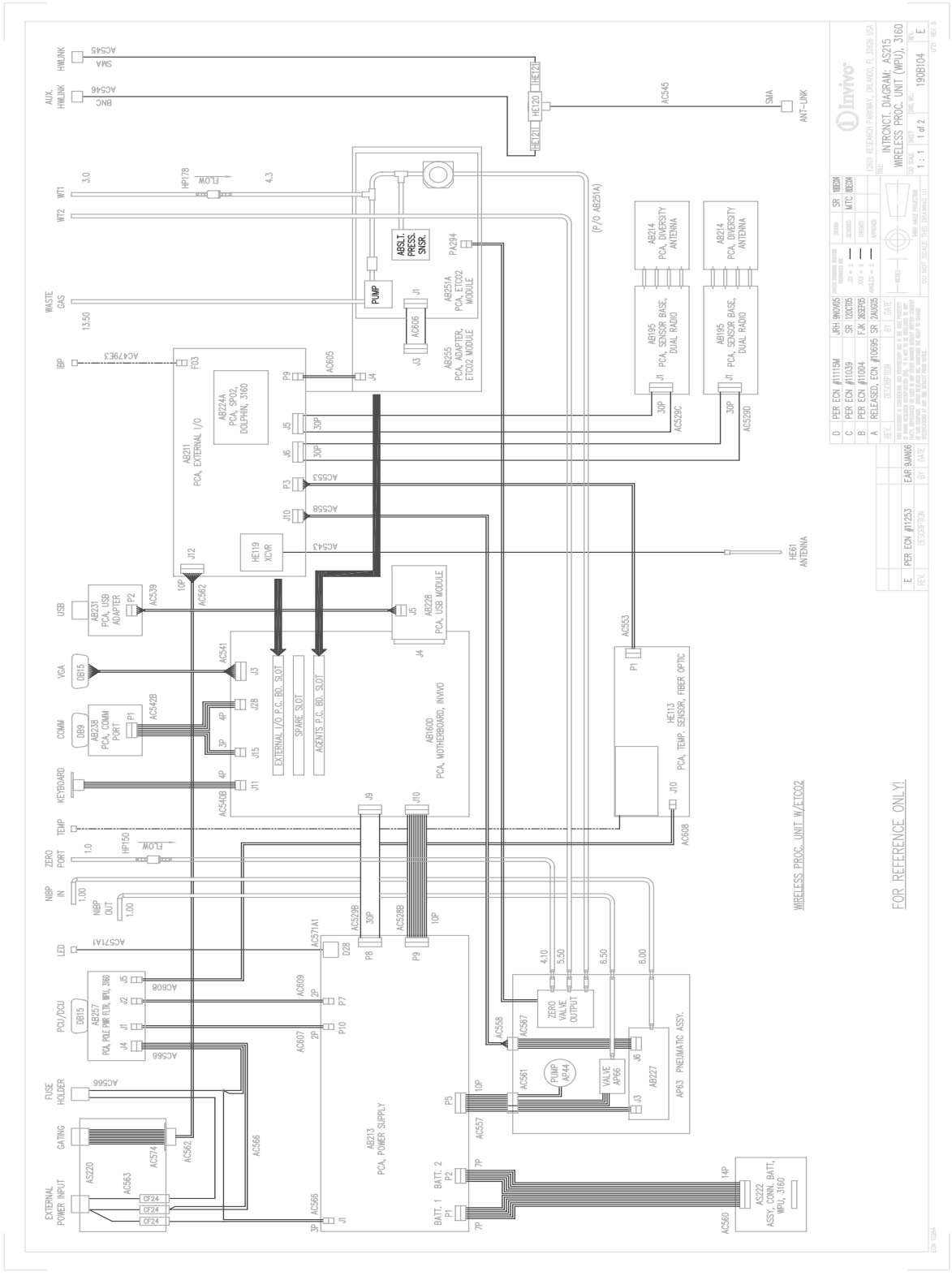
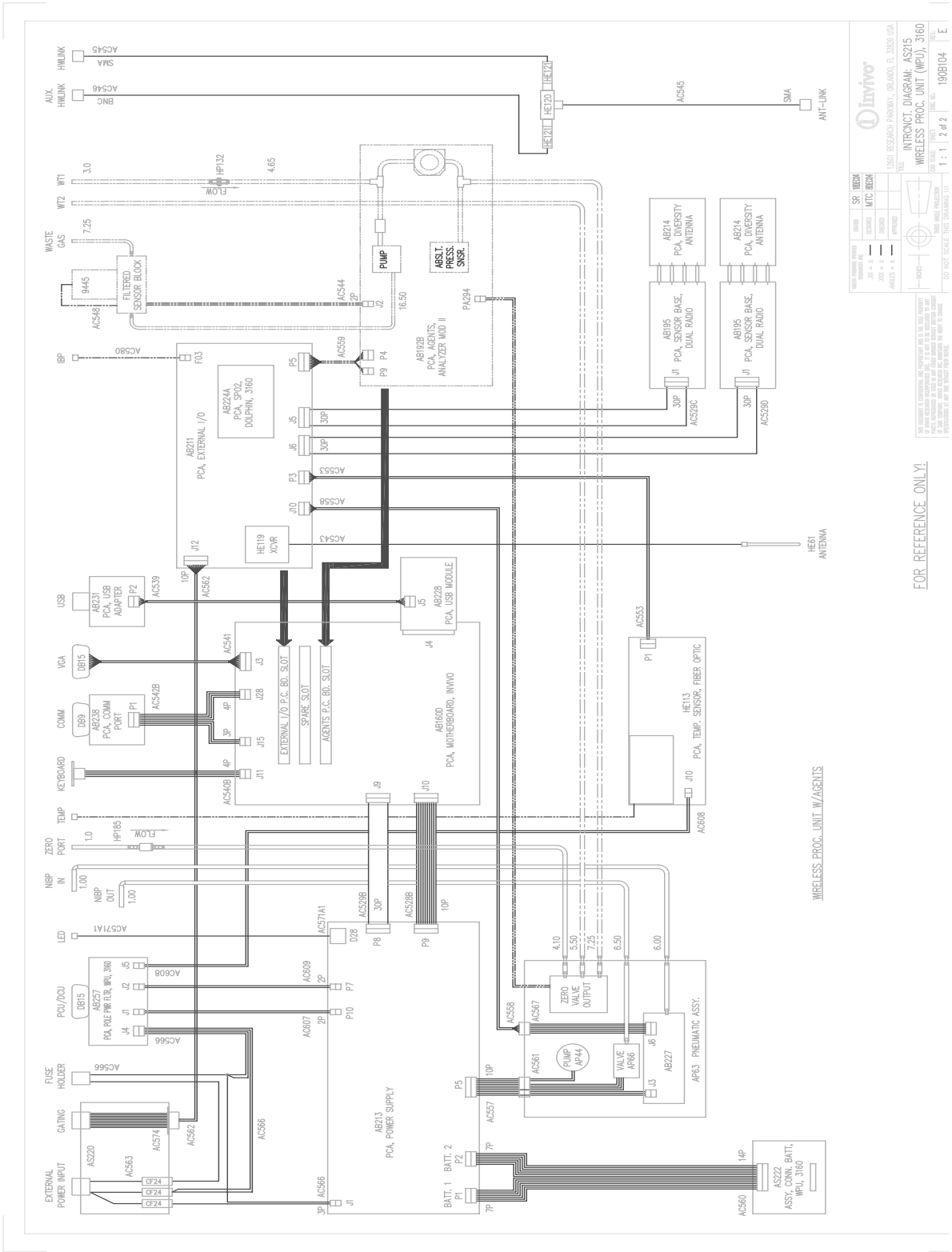
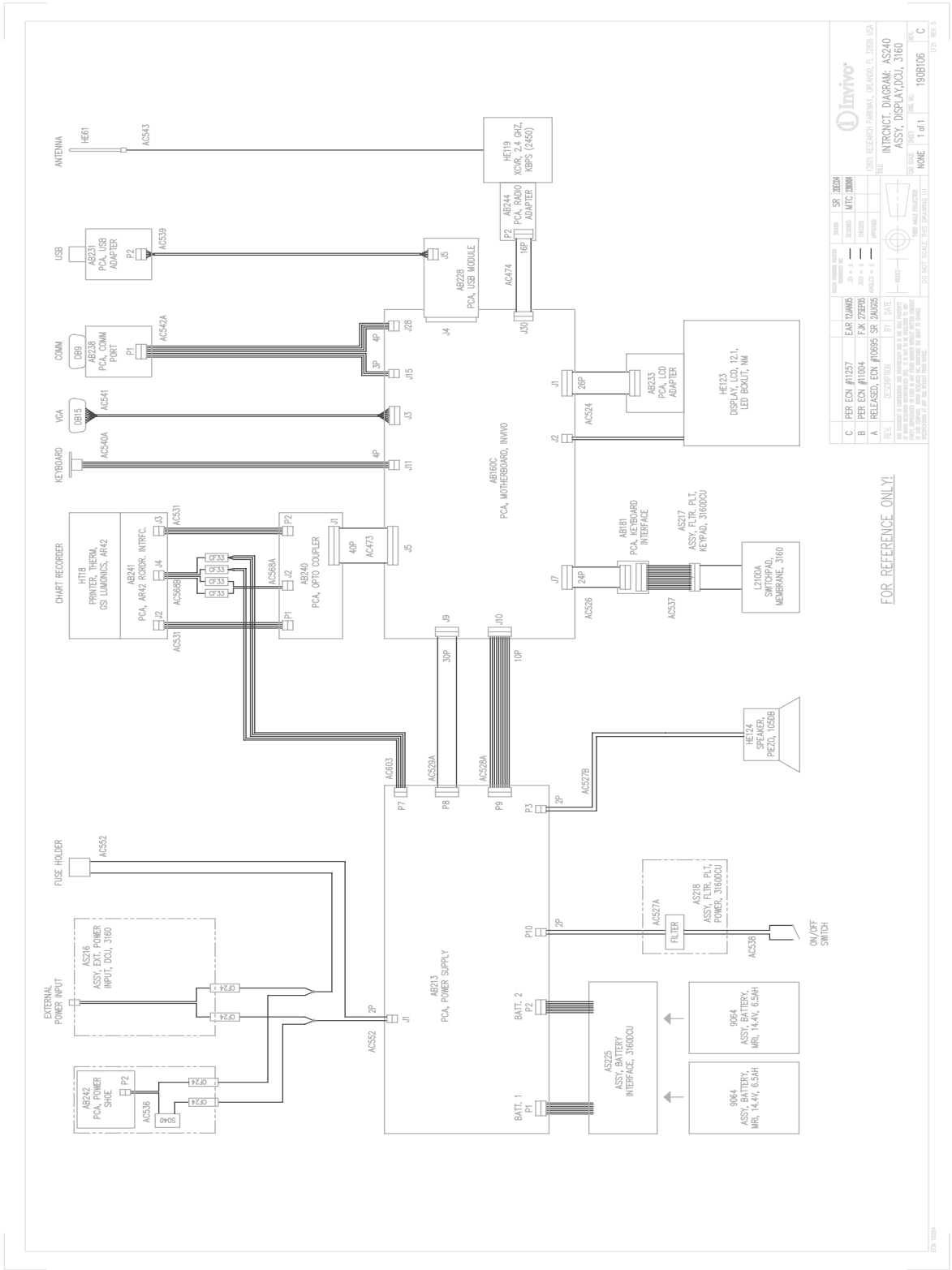
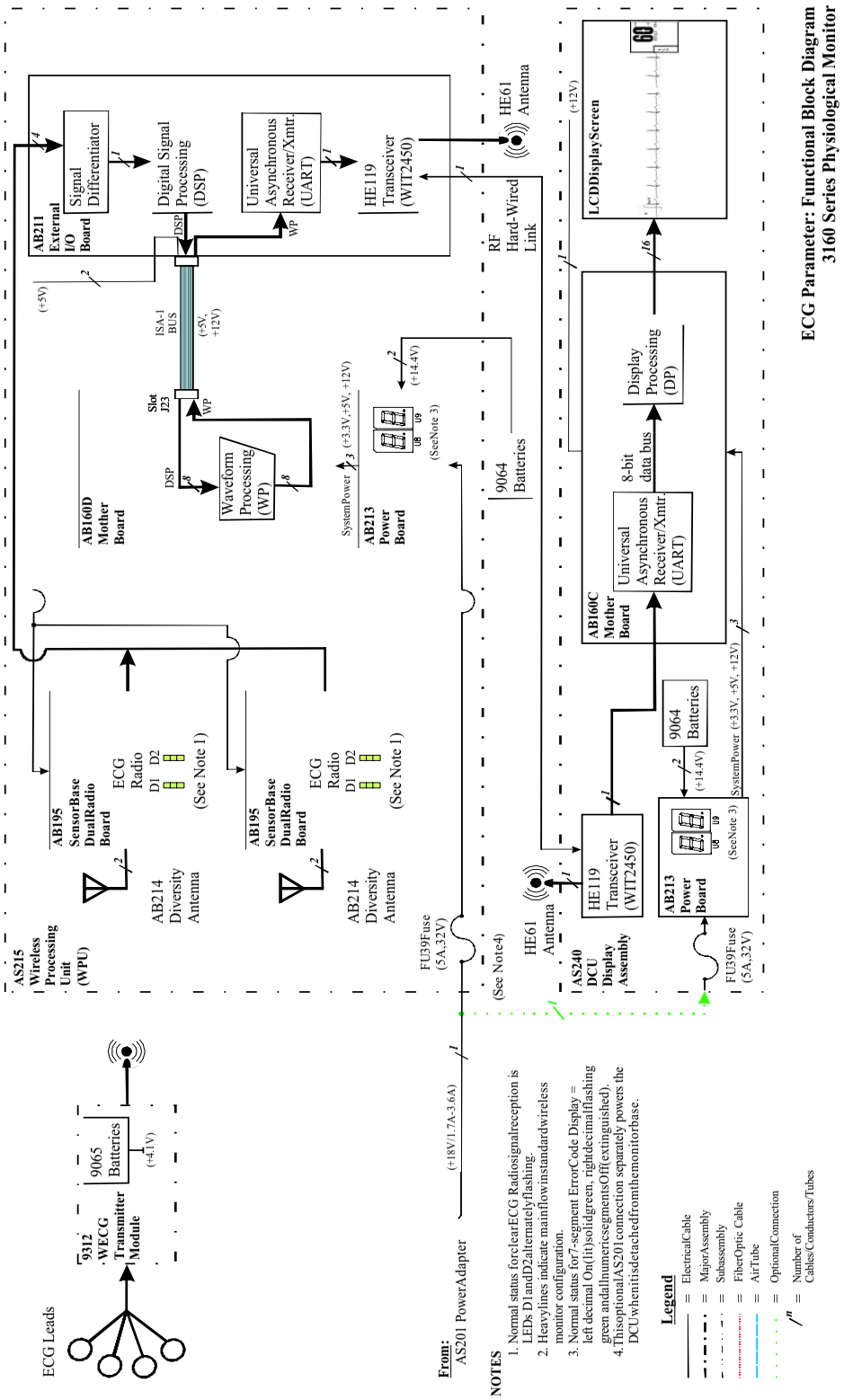
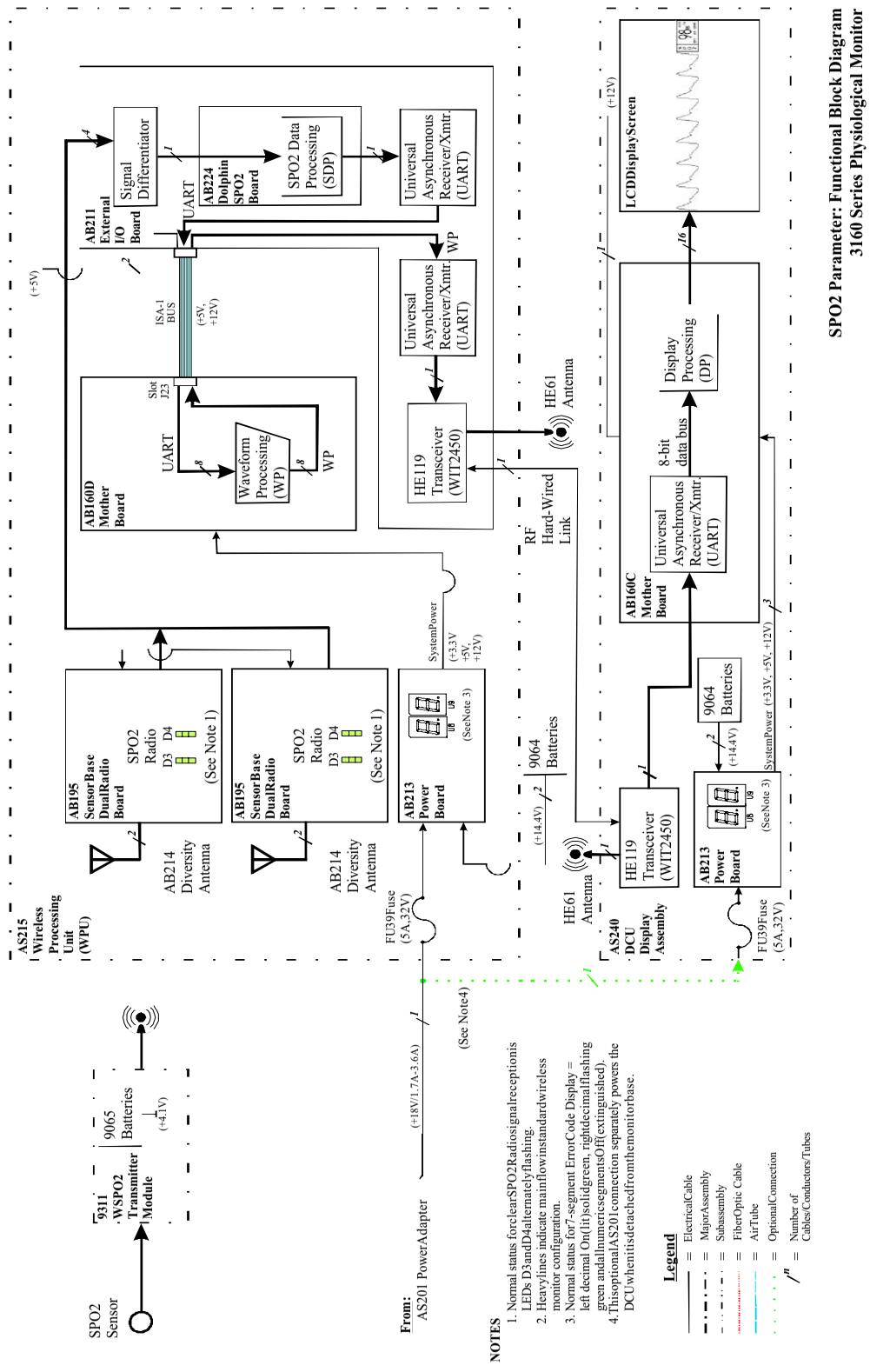

FOR REFERENCE ONLY!
DCU
3160DCU
REF. DWG. 19080106
WPU
AS215
REF. DWG. 19080104
PCU
AS219
ON/OFF SWITCH
LED
NIBP IN
NIBP OUT
ZERO
TEMP
P1/D1
P2/D2
GAS IN
AB249
AC602
AS226
AC564
AC572A1
AC579
AC580
AC547
SHRINK TUBE
RIGID TUBE
MARON TUBE
WT1
WT2
HP117
HP115
HP09-2
HP09-1
HP115-1
IBP
TEMP
ZERO
NIBP OUT
NIBP IN
LED
PCU/DCU
HWLINK
SWA
4P
6P
14P
DB15
AB245
PCA, POWER SHOE
J4
AB234
PCA, BATTERY INTRFC.
9064
BATTERY
PIPE
INTRCNCT. DIAGRAM: 3160
MRI COMPATIBLE P/NT. MNTRNG. SYS.
19080102
D
1 of 1
1 : 1


INTRCNCT. DIAGRAM: AS215
WIRELESS PROC. UNIT (WPU), 3160
190B104 E
AB211 PCA, EXTERNAL I/O
AB224A PCA, SPO2, DOLPHIN, 3160
AB231 PCA, USB ADAPTER
AB238 PCA, COMM PORT
AB257 PCA, PDEF, PMW, FLTR, WPU, 3160
AB213 PCA, POWER SUPPLY
AB160D PCA, MOTHERBOARD, INVIVO
AB228 PCA, USB MODULE
AB255 PCA, ADAPTER, ETCO2 MODULE
AB251A PCA, ETCO2 MODULE
AB214 PCA, DIVERSITY ANTENNA
AB195 PCA, SENSOR, BASE, DUAL RADIO
HE113 PCA, TEMP. SENSOR, FIBER OPTIC
AB227 PNEUMATIC ASSY.
AS220
AS222 ASSY, CONN, BATT, WPU, 3160
HE61 ANTENNA
ABS.T. PRESS. SNSR.
PUMP
ZERO VALVE OUTPUT
EXTERNAL I/O P.C. BD. SLOT
SPARE SLOT
AGENTS P.C. BD. SLOT
WIRELESS PROC. UNIT W/ETCO2
FOR REFERENCE ONLY!

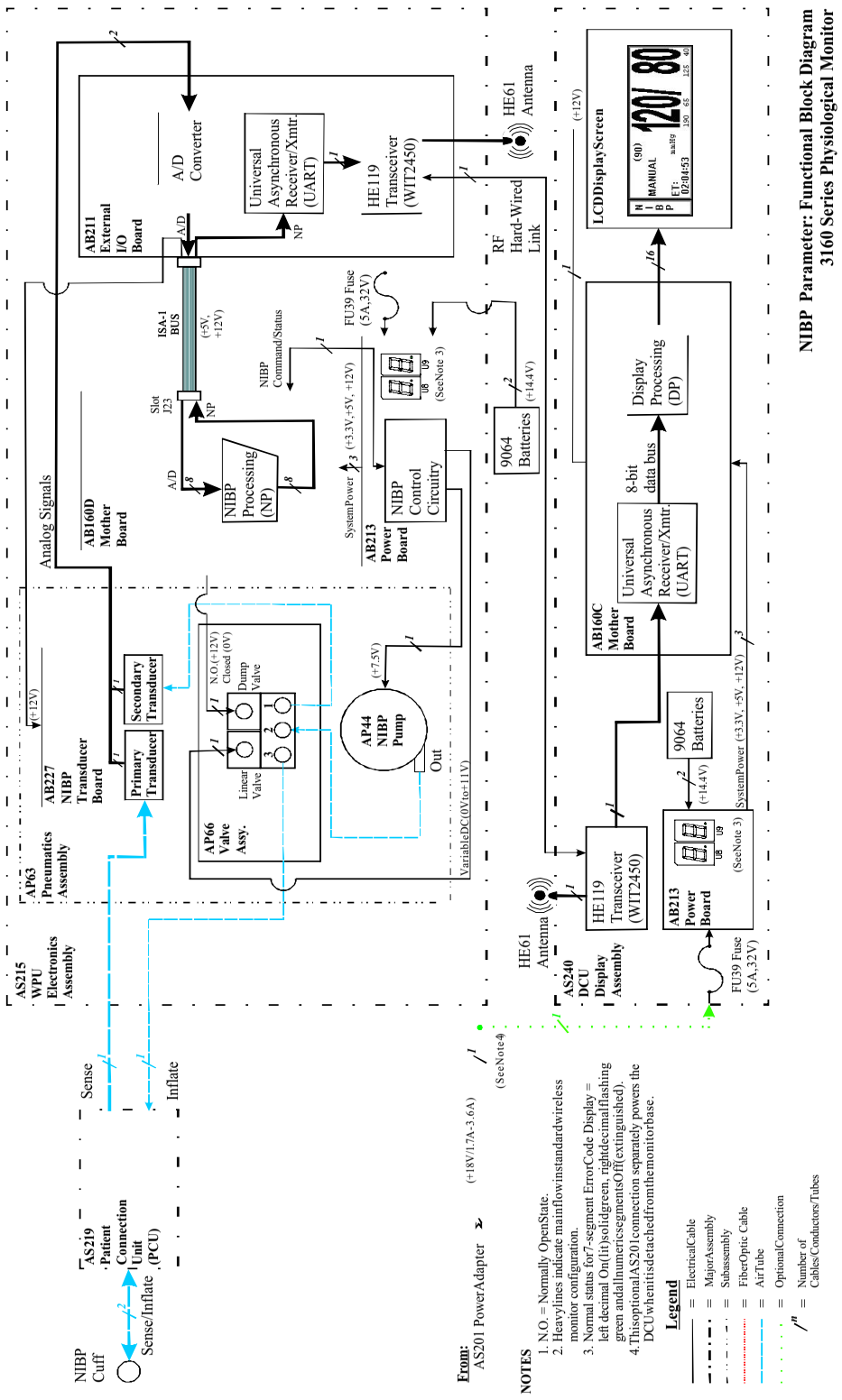

INTRCNCT. DIAGRAM: AS215
WIRELESS PROC. UNIT (WPU), 3160
190B104
FOR REFERENCE ONLY!
WIRELESS PROC. UNIT W/AGENTS
AB192B PCA, AGENTS, ANAALTZER MOD II
AB211 PCA, EXTERNAL I/O
AB224A PCA, SPO2, DOLPHIN, 3160
AB213 PCA, POWER SUPPLY
AB160D PCA, MOTHERBOARD, INVIVO
AB228 PCA, USB MODULE
AB231 PCA, USB ADAPTER
AB238 PCA, COMM PORT
AB257 PCA, PASE PWR FLTR, WPU, 3160
AB214 PCA, DIVERSITY ANTENNA
AB195 PCA, SENSOR BASE, DUAL RADIO
HE113 PCA, TEMP. SENSOR, FIBER OPTIC
HE119 XCVR
HE61 ANTENNA
FILTERED SENSOR BLOCK
ABSL. PRESS. SNSR.
PUMP
AP63 PNEUMATIC ASSY.
AS220 EXTERNAL POWER INPUT
AS222 ASSY, CONN, BATT, WPU, 3160
EXTERNAL I/O P.C. BD. SLOT
SPARE SLOT
AGENTS P.C. BD. SLOT
ANT-LINK
SMA
BNC
USB
VGA
COMM
KEYBOARD
TEMP
ZERO PORT
NIBP IN
NIBP OUT
LED
PCU/DCU
FUSE HOLDER
GATING
WATER TRAP
WASTE GAS
AUX. HWLINK
HWLINK

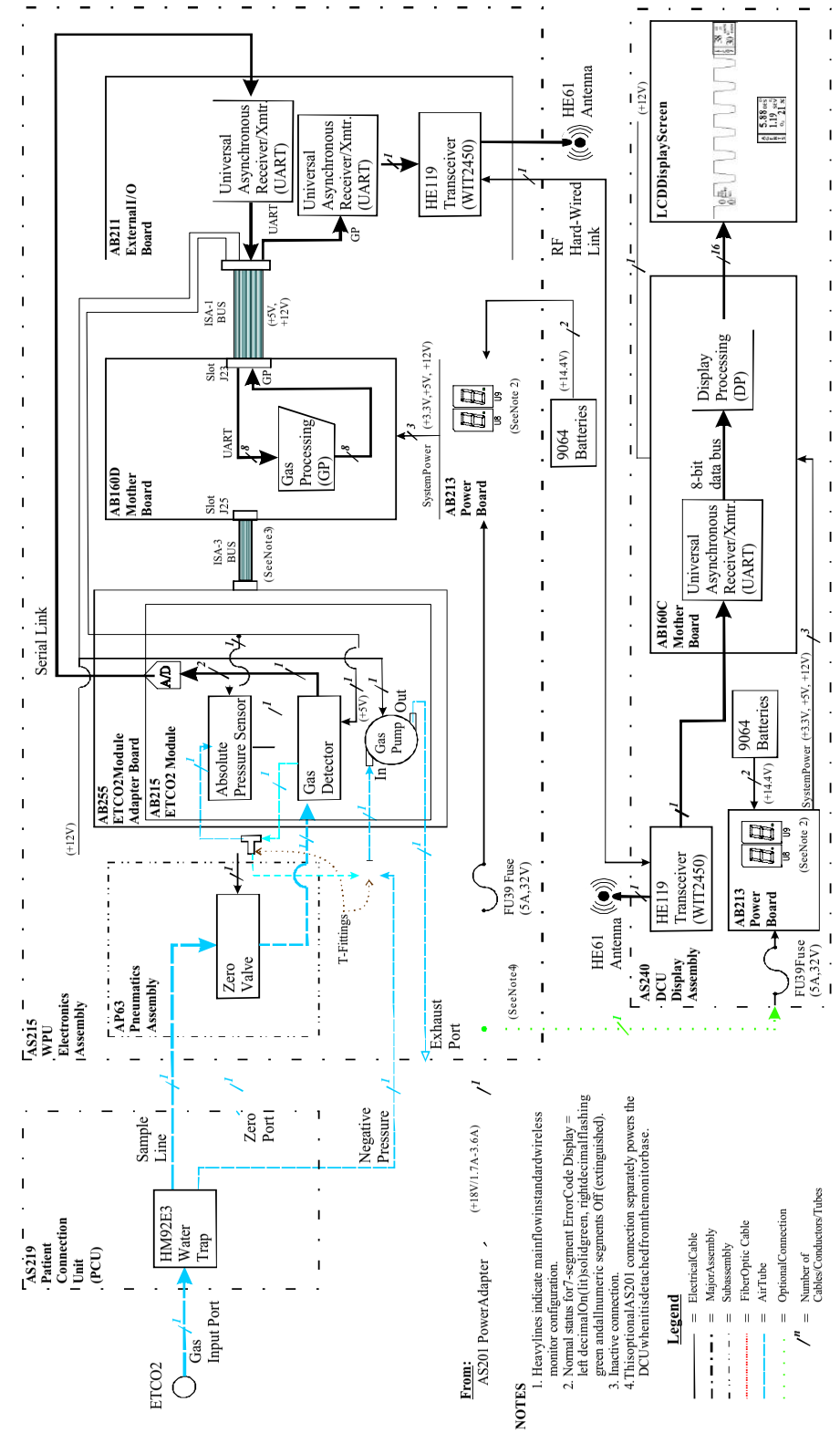

ANTENNA
HE61
AC543
HE119
XCVR, 2.4 GHZ, KBPS (2450)
AB244
PCA, RADIO ADAPTER
USB
AB231
PCA, USB ADAPTER
AC539
AB228
PCA, USB MODULE
AC474
COMM
DB9
AB238
PCA, COMM PORT
AC542A
VGA
DB15
AC541
KEYBOARD
AC540A
AB160C
PCA, MOTHERBOARD, INVIVO
AB233
PCA, LCD ADAPTER
AC524
HE123
DISPLAY; LCD, 12.1, LED BCKLT, NM
CHART RECORDER
HT18
PRINTER, THERM., GSI LUMONICS, AR42
AB241
PCA, AR42 RCRDR. INTRFC.
AC531
AC568B
AC568A
AB240
PCA, OPTO COUPLER
AC473
AB181
PCA, KEYBOARD INTERFACE
AS217
ASSY, FLTR. PLT, KEYPAD, 3160DCU
AC526
AC537
L2100A
SWITCHPAD, MEMBRANE, 3160
HE124
SPEAKER, PIEZO, 1050B
AC603
AC529A
AC528A
AC527B
FUSE HOLDER
AC552
EXTERNAL POWER INPUT
AS216
ASSY, EXT. POWER INPUT, DCU, 3160
AB242
PCA, POWER SHOE
AC536
AB213
PCA, POWER SUPPLY
AS225
ASSY, BATTERY INTERFACE, 3160DCU
9064
ASSY, BATTERY, MRS, 14.4V, 6.5AH
AC527A
FILTER
AS218
ASSY, FLTR. PLT, POWER, 3160DCU
AC538
ON/OFF SWITCH
FOR REFERENCE ONLY!
INTRCNCT. DIAGRAM: AS240
ASSY, DISPLAY,DCU, 3160
190B106
C
NONE
1 of 1


ECG Parameter: Functional Block Diagram
3160 Series Physiological Monitor
ECG Leads
9312 WECG Transmitter Module
9065 Batteries
(+4.1 V)
From: AS201 PowerAdapter
(+18V/1.7A-3.6A)
AS215 Wireless Processing Unit (WPU)
AB195 SensorBase DualRadio Board
ECG Radio
D1 D2
AB214 Diversity Antenna
(See Note 1)
AB160D Mother Board
DSP
Waveform Processing (WP)
Slot J23
ISA-1 BUS
(+5V, +12V)
AB211 External I/O Board
Signal Differentiator
Digital Signal Processing (DSP)
Universal Asynchronous Receiver/Xmtr. (UART)
HE119 Transceiver (WIT2450)
HE61 Antenna
RF Hard-Wired Link
AB213 Power Board
SystemPower (+3.3V, +5V, +12V)
(+14.4V)
(SeeNote 3)
9064 Batteries
FU39Fuse (5A,32V)
(See Note4)
AS240 DCU Display Assembly
AB160C Mother Board
8-bit data bus
Display Processing (DP)
LCDDisplayScreen
(+12V)
NOTES
1. Normal status forclearECG Radiosignalreception is LEDs D1andD2alternatelyflashing.
2. Heavylines indicate mainflowinstandardwireless monitor configuration.
3. Normal status for7-segment ErrorCode Display = left decimal On(lit)solidgreen, rightdecimalflashing green andallnumericsegmentsOff(extinguished).
4. ThisoptionalAS201connection separately powers the DCUwhenitisdetachedfromthemonitorbase.
Legend
ElectricalCable
MajorAssembly
Subassembly
FiberOptic Cable
AirTube
OptionalConnection
Number of Cables/Conductors/Tubes

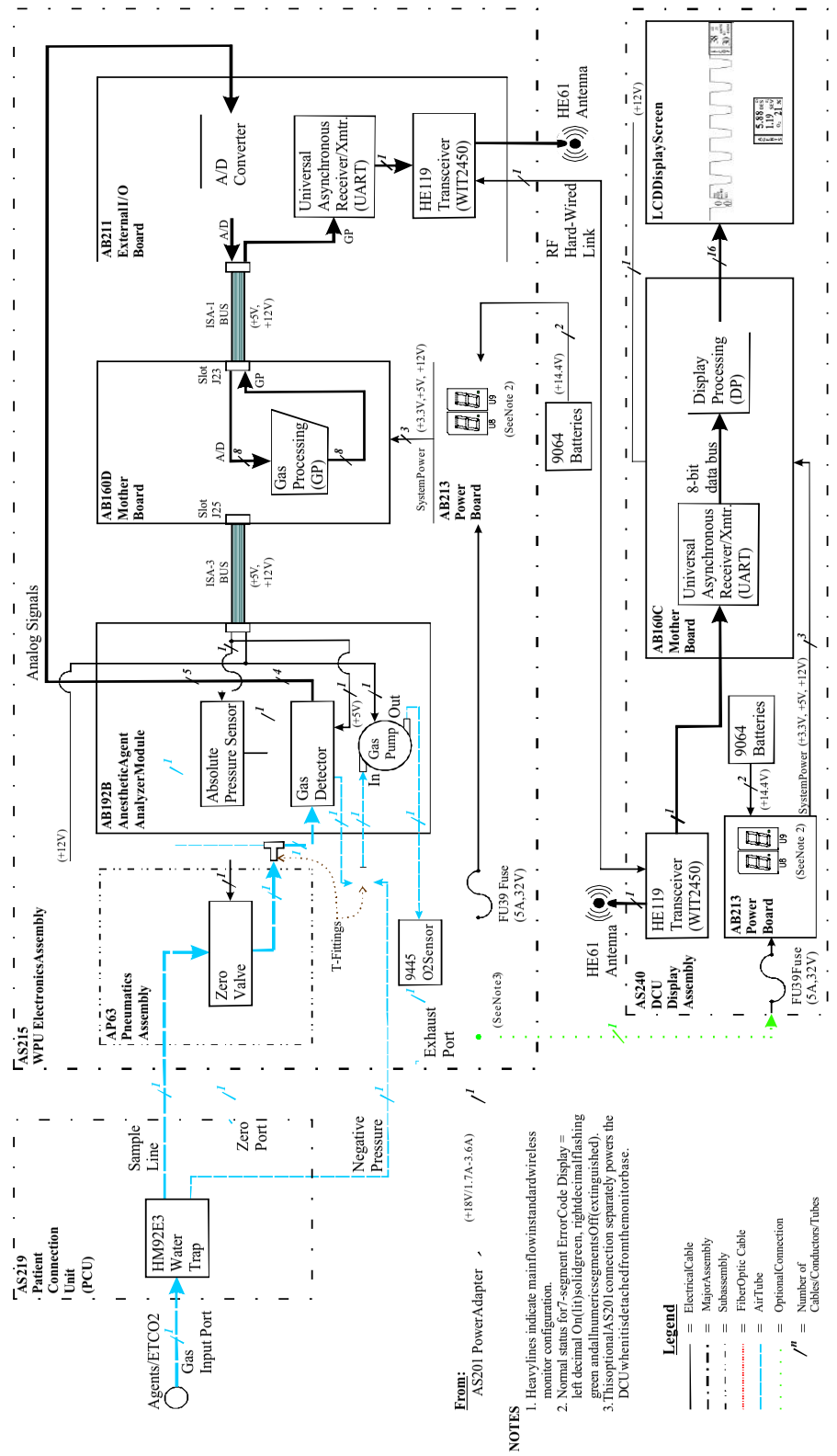


SPO2 Parameter: Functional Block Diagram
3160 Series Physiological Monitor

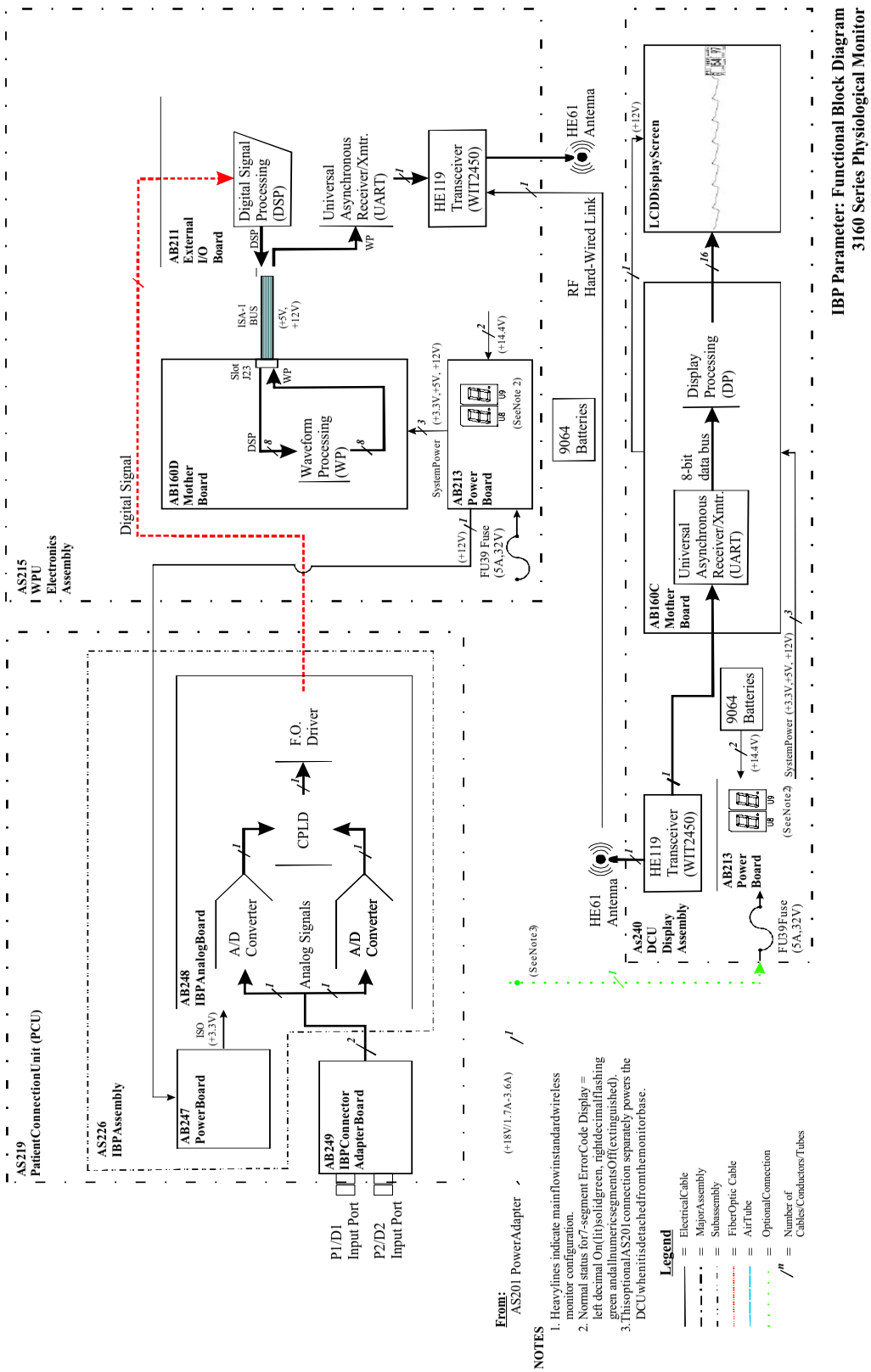

NIBP Parameter: Functional Block Diagram
3160 Series Physiological Monitor
AS215 WPU Electronics Assembly
AP63 Pneumatics Assembly
AB227 NIBP Transducer Board
AB160D Mother Board
AB211 External I/O Board
AB213 Power Board
AB160C Mother Board
AS240 DCU Display Assembly
AS219 Patient Connection Unit (PCU)
Analog Signals
A/D Converter
Universal Asynchronous Receiver/Xmtr. (UART)
HE119 Transceiver (WIT2450)
HE61 Antenna
RF Hard-Wired Link
ISA-1 BUS
NIBP Processing (NP)
NIBP Command/Status
NIBP Control Circuitry
FU39 Fuse (5A,32V)
9064 Batteries
Display Processing (DP)
8-bit data bus
LCDDisplayScreen
Secondary Transducer
Primary Transducer
AP66 Valve Assy.
Linear Valve
Dump Valve
AP44 NIBP Pump
Sense
Inflate
NIBP Cuff
Sense/Inflate
From: AS201 PowerAdapter
NOTES
Legend
ElectricalCable
MajorAssembly
Subassembly
FiberOptic Cable
AirTube
OptionalConnection
Number of Cables/Conductors/Tubes

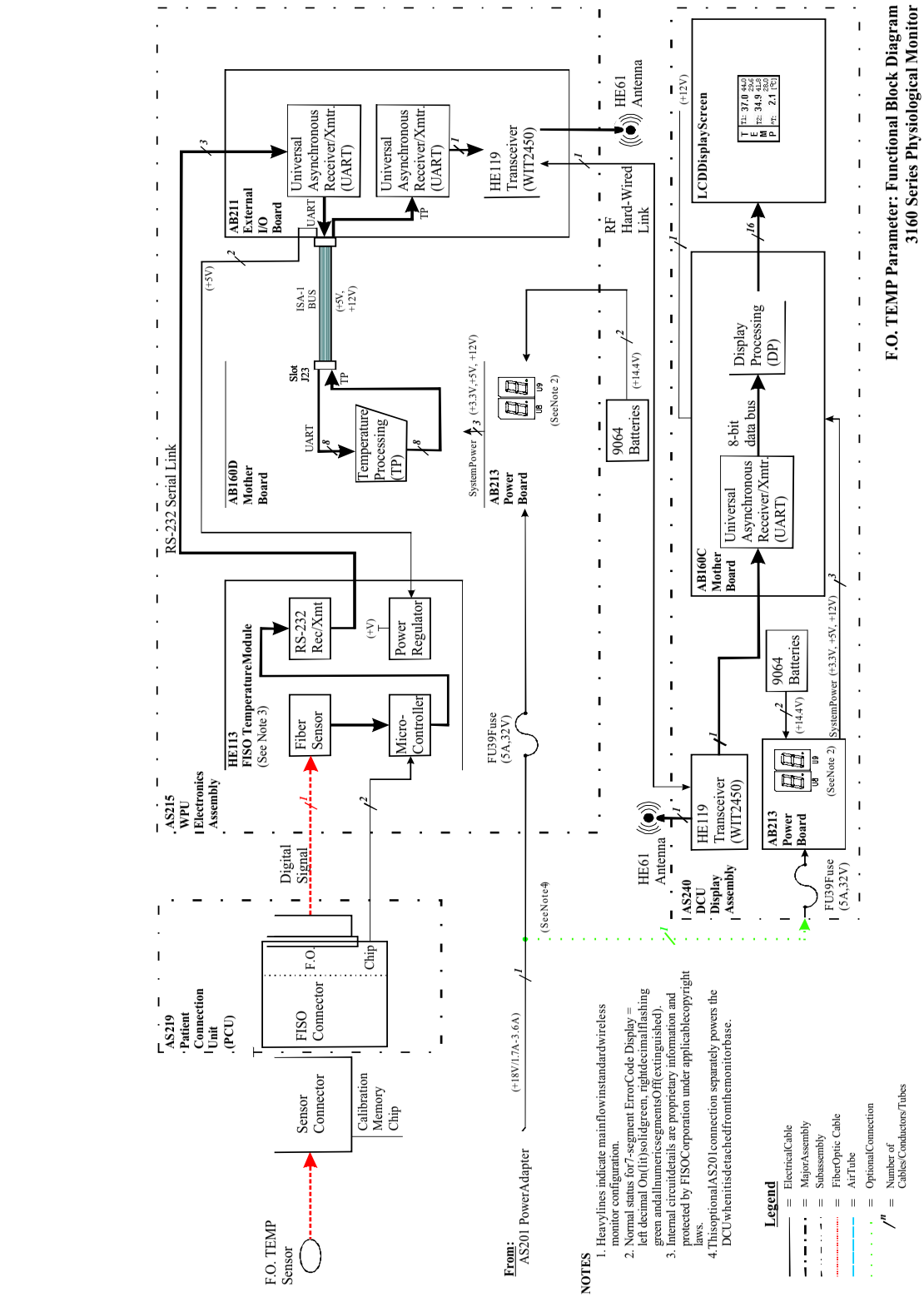


ETCO2 Parameter: Functional Block Diagram
3160 Series Physiological Monitor

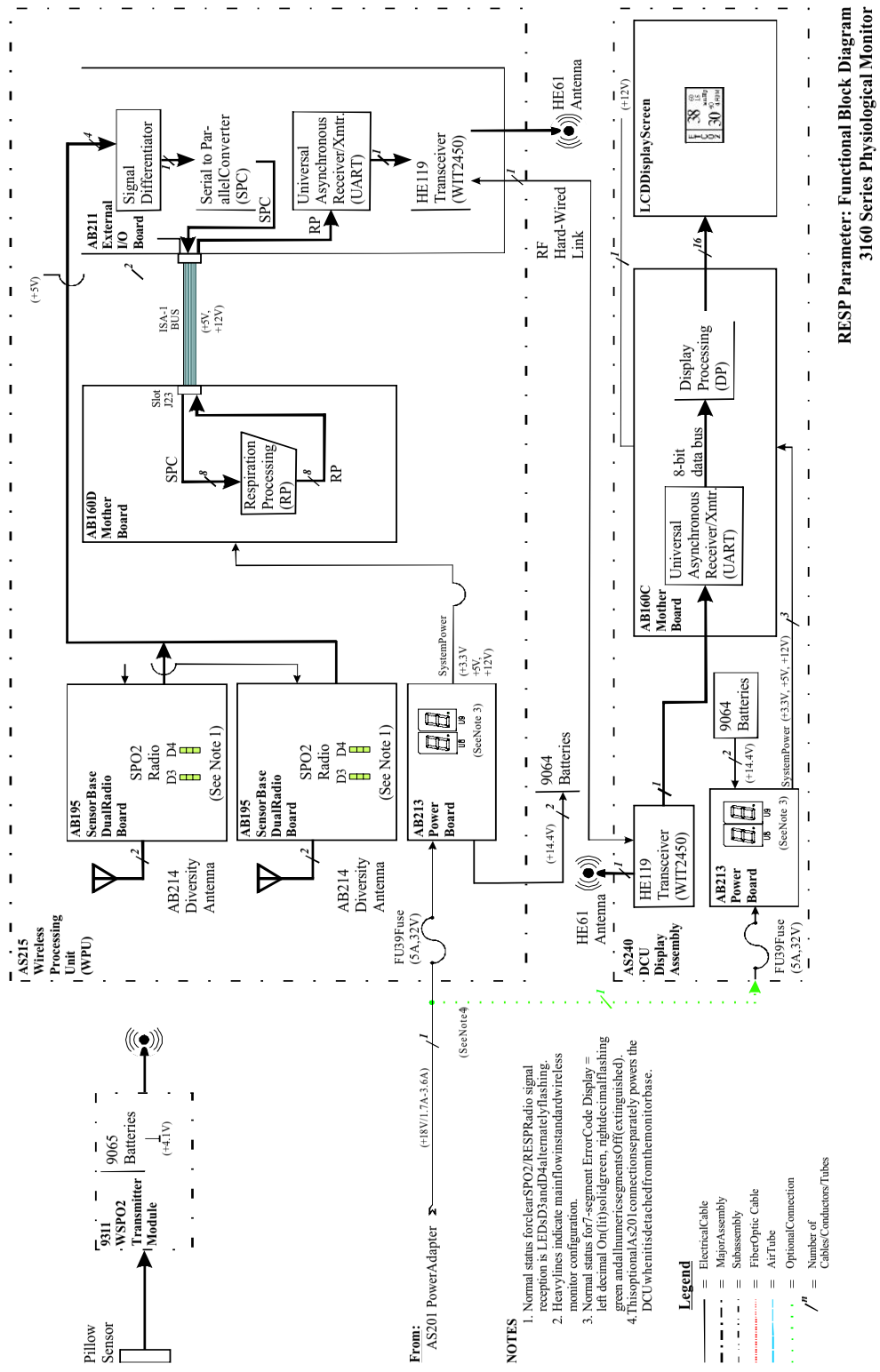


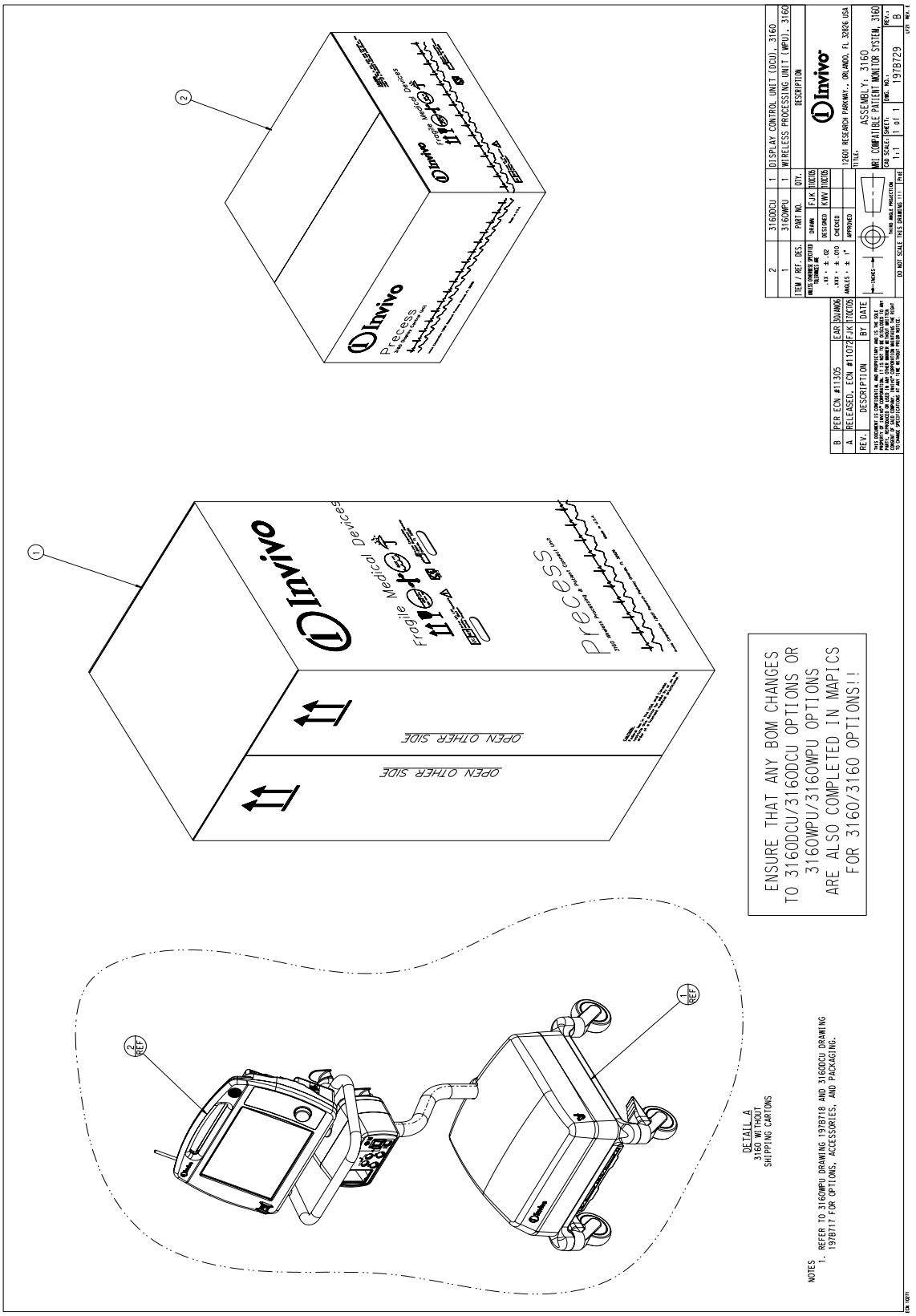
Agents Parameter: Functional Block Diagram
3160 Series Physiological Monitor


AS219
PatientConnectionUnit (PCU)
AS226
IBPAssembly
AS215
WPU
Electronics
Assembly
AB247
PowerBoard
ISO
(+3.3V)
AB248
IBPAnalogBoard
A/D
Converter
Analog Signals
A/D
Converter
CPLD
F.O.
Driver
AB249
IBPConnector
AdapterBoard
P1/D1
Input Port
P2/D2
Input Port
Digital Signal
AB160D
Mother
Board
DSP
Waveform
Processing
(WP)
Slot
J23
WP
ISA-1
BUS
(+5V,
+12V)
AB211
External
I/O
Board
DSP
Digital Signal
Processing
(DSP)
Universal
Asynchronous
Receiver/Xmtr.
(UART)
WP
HE119
Transceiver
(WIT2450)
HE61
Antenna
RF
Hard-Wired Link
SystemPower
(+3.3V,+5V, +12V)
AB213
Power
Board
U8
U9
(SeeNote 2)
(+14.4V)
9064
Batteries
FU39 Fuse
(5A,32V)
(+12V)
(+18V/1.7A-3.6A)
From:
AS201 PowerAdapter
(SeeNote3)
HE61
Antenna
HE119
Transceiver
(WIT2450)
As240
DCU
Display
Assembly
AB213
Power
Board
U8
U9
(SeeNote2)
9064
Batteries
(+14.4V)
FU39Fuse
(5A,32V)
SystemPower (+3.3V,+5V, +12V)
AB160C
Mother
Board
Universal
Asynchronous
Receiver/Xmtr.
(UART)
8-bit
data bus
Display
Processing
(DP)
LCDDisplayScreen
(+12V)
NOTES
1. Heavylines indicate mainflowinstandardwireless monitor configuration.
2. Normal status for7-segment ErrorCode Display = left decimal On(lit)solidgreen, rightdecimalflashing green andallnumericsegmentsOff(extinguished).
3.ThisoptionalAS201connection separately powers the DCUwhenitisdetachedfromthemonitorbase.
Legend
ElectricalCable
MajorAssembly
Subassembly
FiberOptic Cable
AirTube
OptionalConnection
Number of
Cables/Conductors/Tubes
IBP Parameter: Functional Block Diagram
3160 Series Physiological Monitor



F.O. TEMP Parameter: Functional Block Diagram
3160 Series Physiological Monitor


AS215 Wireless Processing Unit (WPU)
AB195 SensorBase DualRadio Board
SPO2 Radio
D3 D4
(See Note 1)
AB214 Diversity Antenna
AB213 Power Board
(SeeNote 3)
FU39Fuse (5A,32V)
9064 Batteries
HE61 Antenna
HE119 Transceiver (WIT2450)
AS240 DCU Display Assembly
AB160C Mother Board
Universal Asynchronous Receiver/Xmtr. (UART)
8-bit data bus
Display Processing (DP)
LCDDisplayScreen
AB160D Mother Board
SPC
Respiration Processing (RP)
RP
Slot J23
ISA-1 BUS
(+5V, +12V)
AB211 External I/O Board
Signal Differentiator
Serial to Par-allelConverter (SPC)
Universal Asynchronous Receiver/Xmtr. (UART)
HE119 Transceiver (WIT2450)
HE61 Antenna
RF Hard-Wired Link
SystemPower
(+3.3V +5V, +12V)
(+5V)
(+12V)
(+14.4V)
(+18V/1.7A-3.6A)
(SeeNote4)
From: AS201 PowerAdapter
Pillow Sensor
9311 WSPO2 Transmitter Module
9065 Batteries
(+4.1V)
SystemPower (+3.3V, +5V, +12V)
RESP Parameter: Functional Block Diagram
3160 Series Physiological Monitor
NOTES
1. Normal status forclearSPO2/RESPRadio signal reception is LEDsD3andD4alternatelyflashing.
2. Heavylines indicate mainflowinstandardwireless monitor configuration.
3. Normal status for7-segment ErrorCode Display = left decimal On(lit)solidgreen, rightdecimalflashing green andallnumericsegmentsOff(extinguished).
4. ThisoptionalAs201connectionseparately powers the DCUwhenitisdetachedfromthemonitorbase.
Legend
ElectricalCable
MajorAssembly
Subassembly
FiberOptic Cable
AirTube
OptionalConnection
Number of Cables/Conductors/Tubes


ENSURE THAT ANY BOM CHANGES
TO 3160DCU/3160DCU OPTIONS OR
3160WPU/3160WPU OPTIONS
ARE ALSO COMPLETED IN MAPICS
FOR 3160/3160 OPTIONS!!
DETAIL A
3160 WITHOUT
SHIPPING CARTONS
NOTES
1. REFER TO 3160WPU DRAWING 1978718 AND 3160DCU DRAWING
1978717 FOR OPTIONS, ACCESSORIES, AND PACKAGING.
OPEN OTHER SIDE
Precess
Invivo

ITEM 64 L2158 SERIES OVERLAY, PCU, 3160 OPTIONS					
PART NO.	STANDARD NIBP	ETCO2 GAS OPTION 1 3160-5-1	ANESTH. AGENTS OPTION 2 3160-5-2	INVASIVE PRESSURE OPTION 1 3160-12-1	TEMPERTURE OPTION 1 3160-15-1
L2158A	X	X			
L2158A	X		X		
L2158B	X	X		X	
L2158B	X		X	X	
L2158C	X	X		X	X
L2158C	X		X	X	X
L2158D	X	X			X
L2158D	X		X		X
L2158H	X			X	
L2158J	X			X	X
L2158M	X				X
L2158R	X				

NETWORK ID 1, 3160WPU-1-1			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
68	L2199	1	LABEL, RADIO NETWORK ID 1, 3160

NETWORK ID 2, 3160WPU-1-2			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
68	L2199A	1	LABEL, RADIO NETWORK ID 2, 3160

NETWORK ID 3, 3160WPU-1-3			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
68	L2199B	1	LABEL, RADIO NETWORK ID 3, 3160

NETWORK ID 4, 3160WPU-1-4			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
68	L2199C	1	LABEL, RADIO NETWORK ID 4, 3160

NETWORK ID 5, 3160WPU-1-5			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
68	L2199D	1	LABEL, RADIO NETWORK ID 5, 3160

NOTES:

1. USE FIXTURE TF0220 TO PROPERLY ALIGN BATTERY PCBS.
2. USE FIXTURE TF0221 TO PROPERLY ALIGN POLE WITH RESPECT TO CASTER BASE.
3. APPLY M007 RED LOCTITE (ITEM 40).

REFERENCE ASSEMBLY INSTRUCTION AI107

REFERENCE INTERCONNECTION DIAGRAM 190B102

68	SEE CHART	--	LABEL,RADIO NETWORK ID, 3160
67	NW11N	2	WASHER,FLAT,#6X.312X.048,SS,NM
66	NS197NM	2	SCR,#1/4-20X7/16LG,SHCS,SS,NM
65	NS26N	6	SCR,#4-40 X 3/8 LG.PHMS-XR,NM

64	L2158-SERIES	--	OVERLAY,PTNT CONNECT UNIT,3160
63	NO06N	1	NUT,HEX,#2-56,SS,NM
62	AC580	1	CABLE, F.O., IBP, PCU, 3160
61	WT17	1.00	HEAT SHRINK,1/4" I.D.,WHITE
60	NW43N	4	WSHR,LCK,SPLT,#6,SS,NM
59	NW41N	8	WSHR,LCK,SPLT,1/4 x.062,SS,NM
58	NW37N	2	WASHER,FLT,1/4X.625X.080,SS,NM
57	NS76N	2	SCR,#4-40 X 3/16,PHMS-XR,SS,NM
56	NS63N	8	SCR, #6-32 X 1/4 LG, FHMS-XR, NM
55	NS193NM	4	SCR,#6-32 X 9/16 LG,FHMS-XR,SS,NM
54	NS191N	2	SCR,1/4-20X1.875LG,HEX,SS,NM
53	NS189N	4	SCR,#1/4-20X.75LG,SHCS,SS,NM
52	NS186N	2	SCR,CAPT,#6-32X7/16LG,PHMS-XR,SS,NM
51	NS180N	4	SCR,#10-32X5/16 LG,FHMS-XR,SS,NM
50	NS179N	2	SCR,#10-24X1/2LG,FHMS-XR,UC,SS,NM
49	NS173N	4	SCR,1/4-20 X 1/2 LG,FHMS-XR,NM
48	NS133N	2	SCR,#6-32 X 1/4LG,FHMS-XR,UC,SS,NM
47	NS118N	4	SCR,1/4-20 X .75LG,PHMS-XR,NM
46	NS10N	8	SCR,#6-32 X 3/8 LG,PHMS-XR,NM
45	NS06N	4	SCR,#6-32 X 1/2 LG,PHMS-XR,NM
44	NS02N	4	SCR,#6-32 X 1/4 LG,PHMS-XR,NM
43	NO05N	4	NUT,HEX,#1/4-20,SS,NM
42	M050	A/R	ADHESIVE, LOCTITE 425, BLU, ASSUR
41	M008A	A/R	M008A ADHSV/SEALNT,RTV,CLEAR,737
40	M007	A/R	ADHESIVE,LOCTITE 262,RED,THDLK
39	L280A	1	LABEL, NETWORK IDENTIFIER
38	L2172	1	LABEL,INFORMATION,3160/3160DCU
37	L2160	1	LABEL,MODEL/SERIAL NO,3160
36	L2114	1	LABEL, EMBEDDED BIOS LICENSES
35	L014	1	LABEL,"ACCEPTED" WO2
34	HP117	1	FITTING,1/16 TUBE CONN,PVDF
33	HP115	138.0	TUBING, VITON, 1/16 ID X 1/8 OD
32	HP09	92.0	TUBING, SBR, .250 X .125 X .0625
31	HM92T	2	RACK, CABLE, PCU, 3160
30	HM92B	1	COVER, REAR, PCU, 3160
29	HM92A	1	COVER, FRONT, PCU, 3160
28	HM91Y	4	BRACKET, COVER MOUNT, WPU, 3160
27	HM91W	1	COVER, WPU, 3160
26	HM91U	1	BASE, CASTER, WPU, 3160
25	HM91AJ	1	SHIELD, EMI, BATT, WPU, 3160
24	HM91AH	1	COVER, BATT, WPU
23	HM91AG	1	BRKT, COVER, REAR, WPU, 3160
22	HM91AB	1	COVER, REAR, WPU, 3160
21	HM90W	1	MOUNT, PCB, POLE, SHOE, 3160
20	HM90V	1	BRACKET, SHOE, POLE MT., 3160
19	HM90T	1	POLE, SUPPORT, 3160
18	HM90K	2	LATCH, SPRING, BATT, DCU/WPU, 3160
17	HM90AP	1	CABLE MANAGER, 3160
16	HM90AN	1	HANDLE, 3160
15	HK26	2	CASTER,SWIVEL,W/LK,4 IN,M10 STEM,NM
14	HK25	2	CASTER, SWIVEL, 4 IN, M10 STEM, NM
13	HC41	2	E-RING, RETAINING, .095 ID
12	HC07	2	CABLE, TIE #4 TY533M
11	H096	2	MOUNT,CABLE TIE,ADHESIV BACKED
10	AS241	1	ASSY, BATTERY POWER, WPU, 3160
9	AS219	1	ASSY,PAT.CNNCTN.UNIT(PCU),3160
8	AS215	1	ASSY,WRLSS.PROC.UNIT(WPU),3160
7	AC579	1	CAB,FIBER OPTIC,SC/ST,TEMP,WPU,3160
6	AC572A1	1	CABLE, FLEXIBLE LIGHT PIPE, ST/ST
5	AC565	1	CABLE,COAX,SMA MALE/SMA MALE,60.OLG.
4	AC564	1	CBL,POLE,MLT-FNCTN INTRCNCT,WPU,3160
1	AB245	1	PCA, POWER SHOE, WPU, 3160
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION

REV.	DESCRIPTION	BY	DATE
E	PER ECN #11396	KWV	21MAR06
D	PER ECN #11352	EAR	8FEB06
C	PER ECN #11255	JRH	4JAN06
B	PER ECN #11243M	EAR	20DEC05
A	RELEASED, PER #11002	FJK	28SEP05

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UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
.XX ± .02
.XXX ± .010
ANGLES ± 1°

INCHES — THIRD ANGLE PROJECTION

DO NOT SCALE THIS DRAWING !!!

DRAWN	KWV	21MAR05
DESIGNED	KWV	21MAR05
CHECKED		
APPROVED		

Invivo

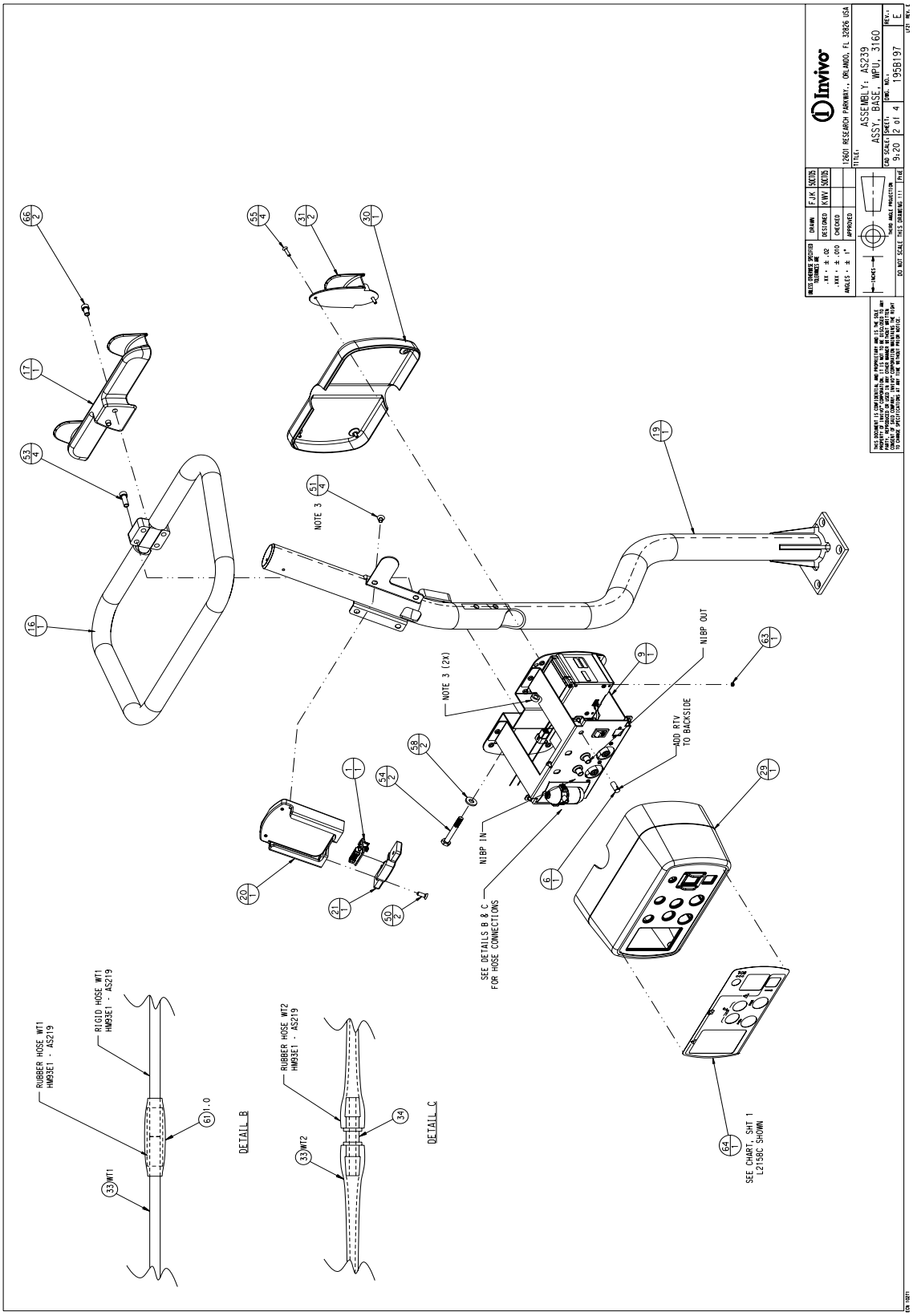
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA

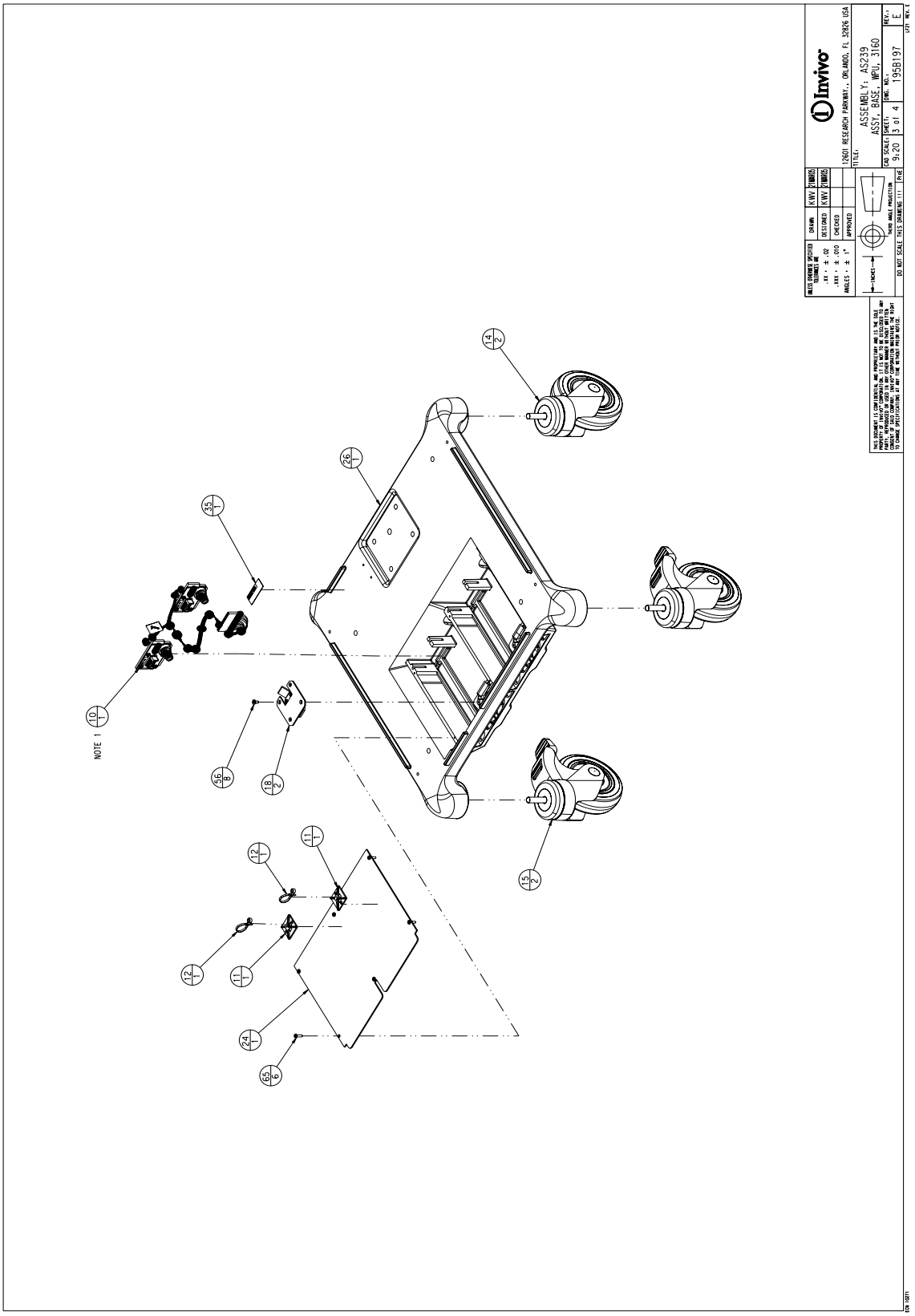
TITLE: ASSEMBLY: AS239
ASSY, BASE, WPU, 3160

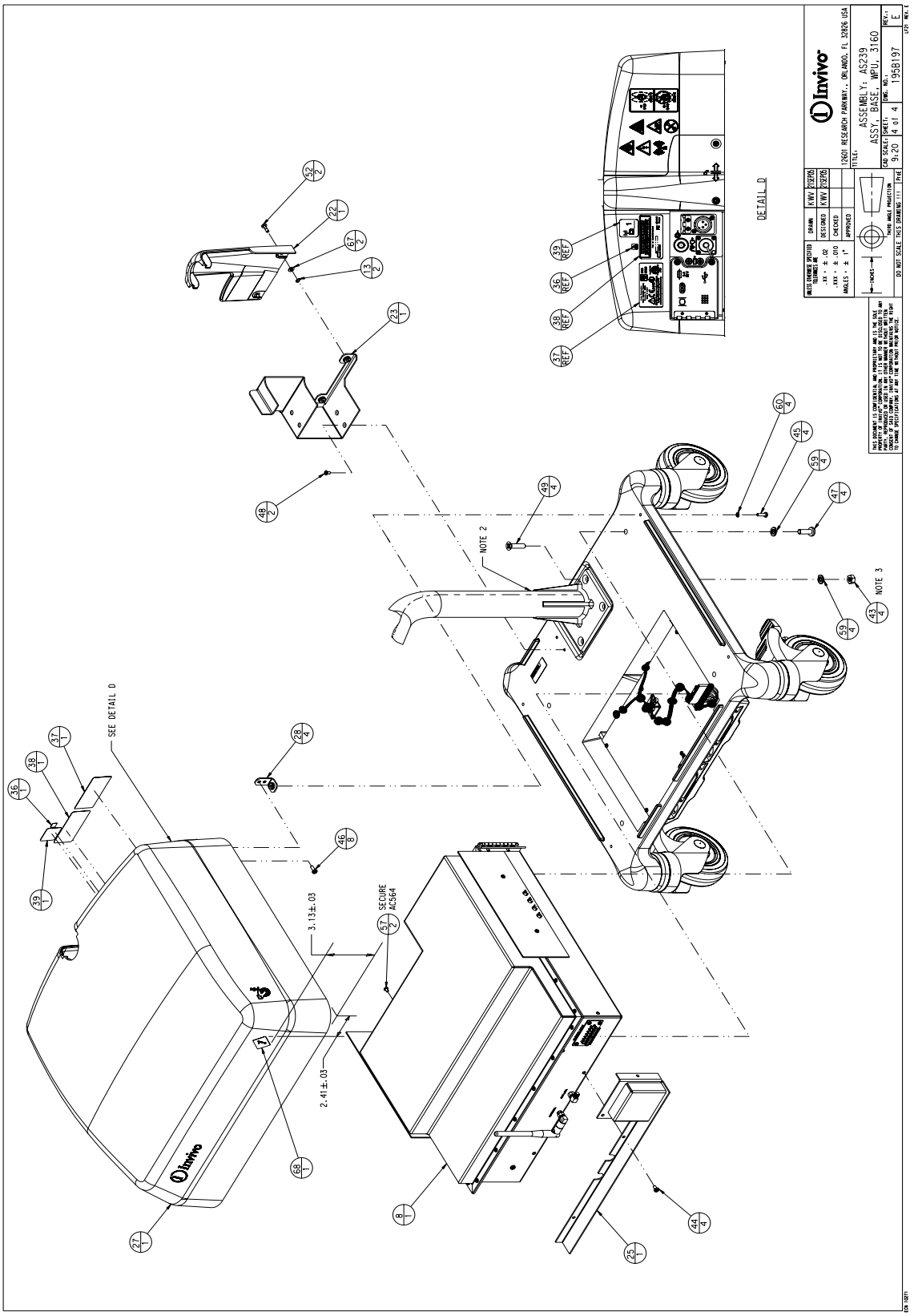
CAD SCALE:	SHEET:	DWG. NO.	REV.:
9:20	1 of 4	195B197	E

ECN 10271

LF21 REV. E


NOTE 3
NOTE 3 (2X)
NIBP OUT
NIBP IN
ADD RTV TO BACKSIDE
SEE DETAILS B & C FOR HOSE CONNECTIONS
SEE CHART, SHT 1 L2158C SHOWN
DETAIL B
DETAIL C
RUBBER HOSE WT1 HM93E1 - AS219
RIGID HOSE WT1 HM93E1 - AS219
RUBBER HOSE WT2 HM93E1 - AS219
Invivo
ASSEMBLY, AS239 ASSY, BASE, WPU, 3160
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
1958197


NOTE 1
Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
ASSEMBLY, AS239
ASSY, BASE, MPU, 3160
1958197
E
3 of 4
9.20


DETAIL D
SEE DETAIL D
NOTE 2
NOTE 3
3.13±.03
2.41±.03
SECURE AC564
Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
ASSEMBLY, AS239
ASSY, BASE, MPU, 3160
DRAWING NO.
195B197
REV.
E
SCALE: 1/4
SHEET 1 of 4
DRAWN
DESIGNED
CHECKED
APPROVED
DO NOT SCALE THIS DRAWING

ETCO2 GAS ANALYSIS, 3160WPU-5-1			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
12	AB251A	1	PCA, LOW FLOW ETCO2 MODULE, 3160
13	AB255	1	PCA, ETCO2 MODULE ADAPTER, 3160
32	AC605	1	CABLE,ETCO2 COMM/PWR,3160
33	AC606	1	CAB,10P,ETCO2 COMM/PWR,3160
41	H162-010CC	2	STRIP,RF,PNL.GSKT,.95,CHMF
42	H162-020CC	2	STRIP,RF,PNL.GSKT,1.9,CHMF
66	HM91D2	1	PLATE, O2 SENSOR
75	HP115	29.95	TUBING, VITON, 1/16 I.D. X 1/8 O.D.
80	HP150	1	RESTRICTOR,.073,.010 ORFC,YEL
82	HP178	1	RESTRICTOR,.073,.006 ORFC,RED
85	HS47	4	STNDFF,.25 HX,M/F,#4-40 x.25LG.BR.
97	NO02N	6	NUT,HEX,#4-40,SS,NM
114	NS50	4	SCR, #4-40 X 1/4 LG, PHMS-NY
127	PG03	2	GUIDE, CARD, NARROW 2.5 LG.

ANESTHETIC AGENTS GAS ANALYSIS, 3160WPU-5-2			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
1	9445	1	ANESTHETIC.OXYGEN SENSOR,DISP.
3	AB192B	1	PCA,AGENTS,ANALYZER,MODII
29	AC559	1	CAB,EXT.I/O,AGNTS.MDL,WPU,3160
37	AP64	1	ASSY, FIO2 SENSER COUPLER, 3160
75	HP115	38.65	TUBING, VITON, 1/16 I.D. X 1/8 O.D.
79	HP132	1	ORIFICE, FLOW CONTROL, .005" DIA.
127	PG03	1	GUIDE, CARD, NARROW 2.5 LG.
129	HP185	1	RESTRICTOR,.073,.016 ORFC,GRAY
71	HM91J	1	HEATSINK, AGENT PCA, WPU, 3160

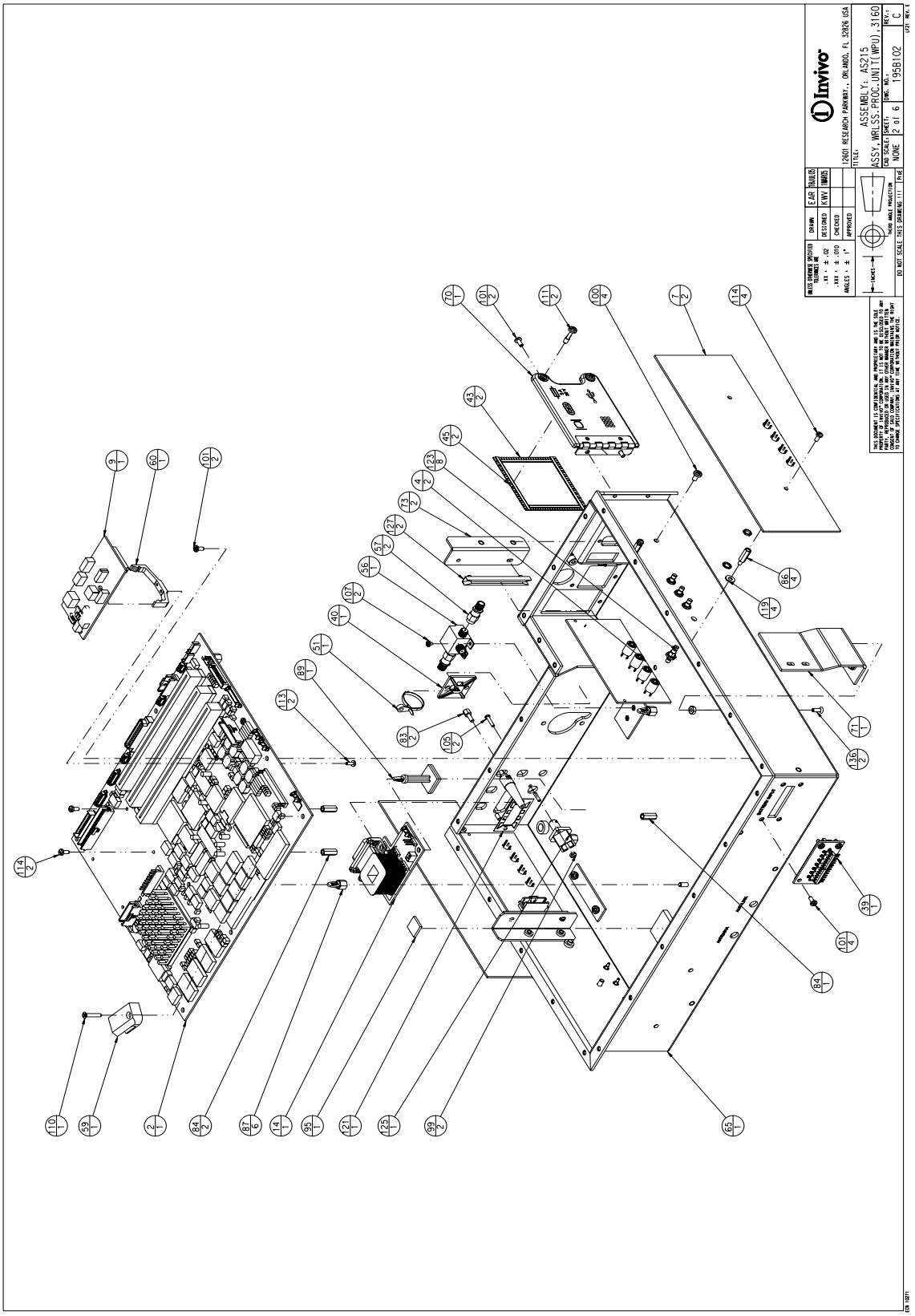
NO GAS ANALYSIS, 3160WPU-5-3			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
41	H162-010CC	2	STRIP,RF,PNL.GSKT,.95,CHMF
42	H162-020CC	2	STRIP,RF,PNL.GSKT,1.9,CHMF
66	HM91D2	1	PLATE, O2 SENSOR

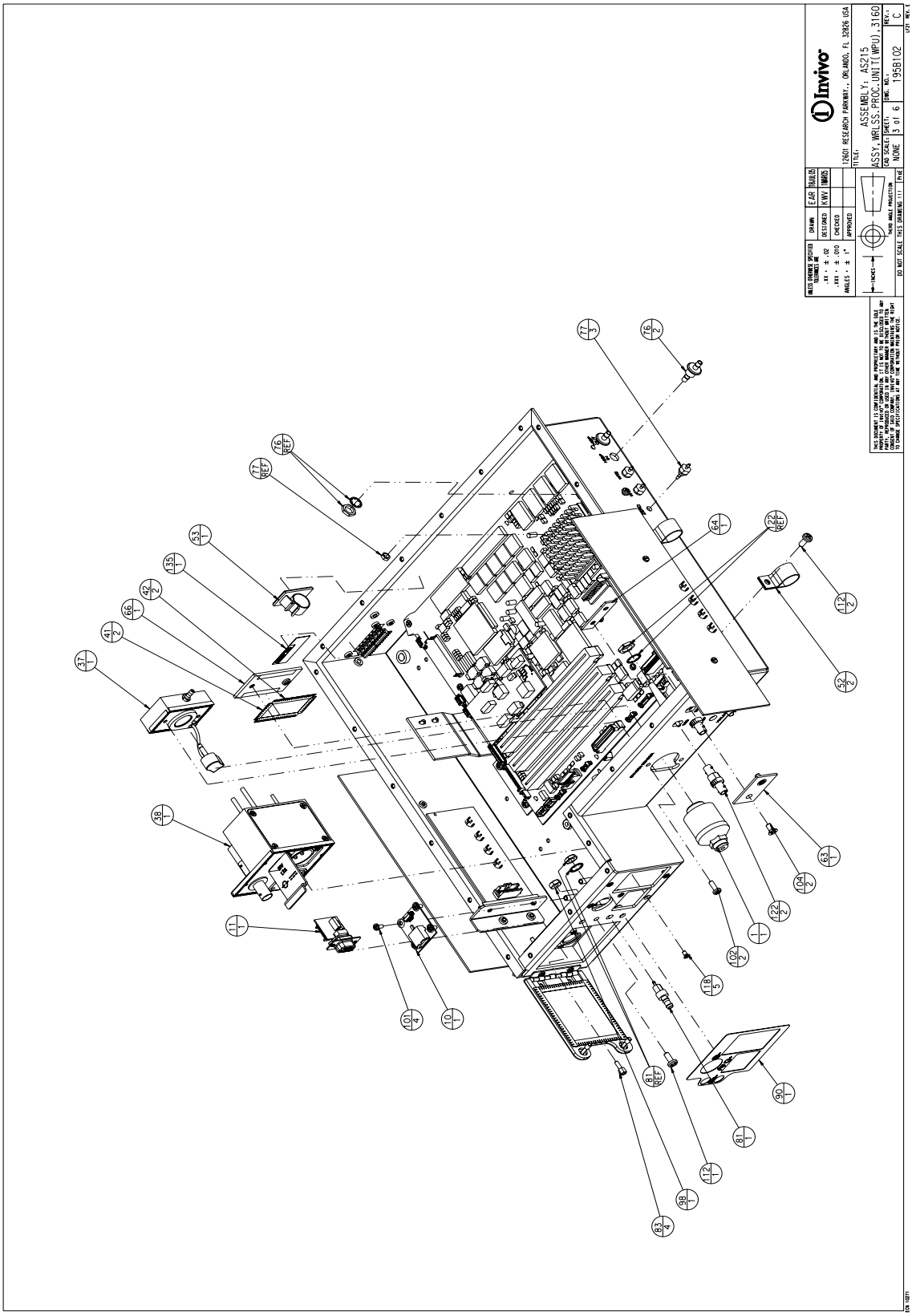
2.4 GHZ WIRELESS COMMUNICATION, 3160WPU-13-1			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
58	HE61	1	ANTENNA, 2.4 GHz, RIGHT ANGLE

HARDWIRED RADIO COMMUNICATION, 3160WPU-13-2			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
35	AC616	1	CAB,COAX, SMA MALE/SMA MALE,.5 LG.

ONE CHANNEL FIBER OPTIC TEMPERATURE, 3160WPU-15-1			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
26	AC553	1	CAB,DATA,TEMP MODULE,WPU,3160
34	AC608	1	CAB,AB257,FISO DATA,WPU,3160
54	HE113	1	PCA, SENSOR, TEMP, F.O.
67	HM91E	1	MOUNT, TEMP.SENSOR, WPU, 3160
97	NO02N	4	NUT,HEX,#4-40,SS,NM
101	NS04N	2	SCR, #4-40 X 1/4 LG, PHMS-XR, NM
118	NS98N	4	SCR, #4-40 X 1/4 LG, FHMS-XR, NM
120	NW44N	2	WSHR,LCK,SPLT,#4,SS,NM

NO TEMPERATURE, 3160WPU-15-2			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
96	NO01N	2	NUT,HEX,#6-32,SS,NM


Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
TITLE: ASSEMBLY, AS215
ASSY, WRLS, CS, PROC-UNIT (WPU), 3160
SIZE: C
DWG. NO.: 1958102
REV.: C
SCALE: NONE
SHEET: 2 of 6
DRAWN: EJAR
DESIGNED: KWV
CHECKED:
APPROVED:
DO NOT SCALE THIS DRAWING
THIRD ANGLE PROJECTION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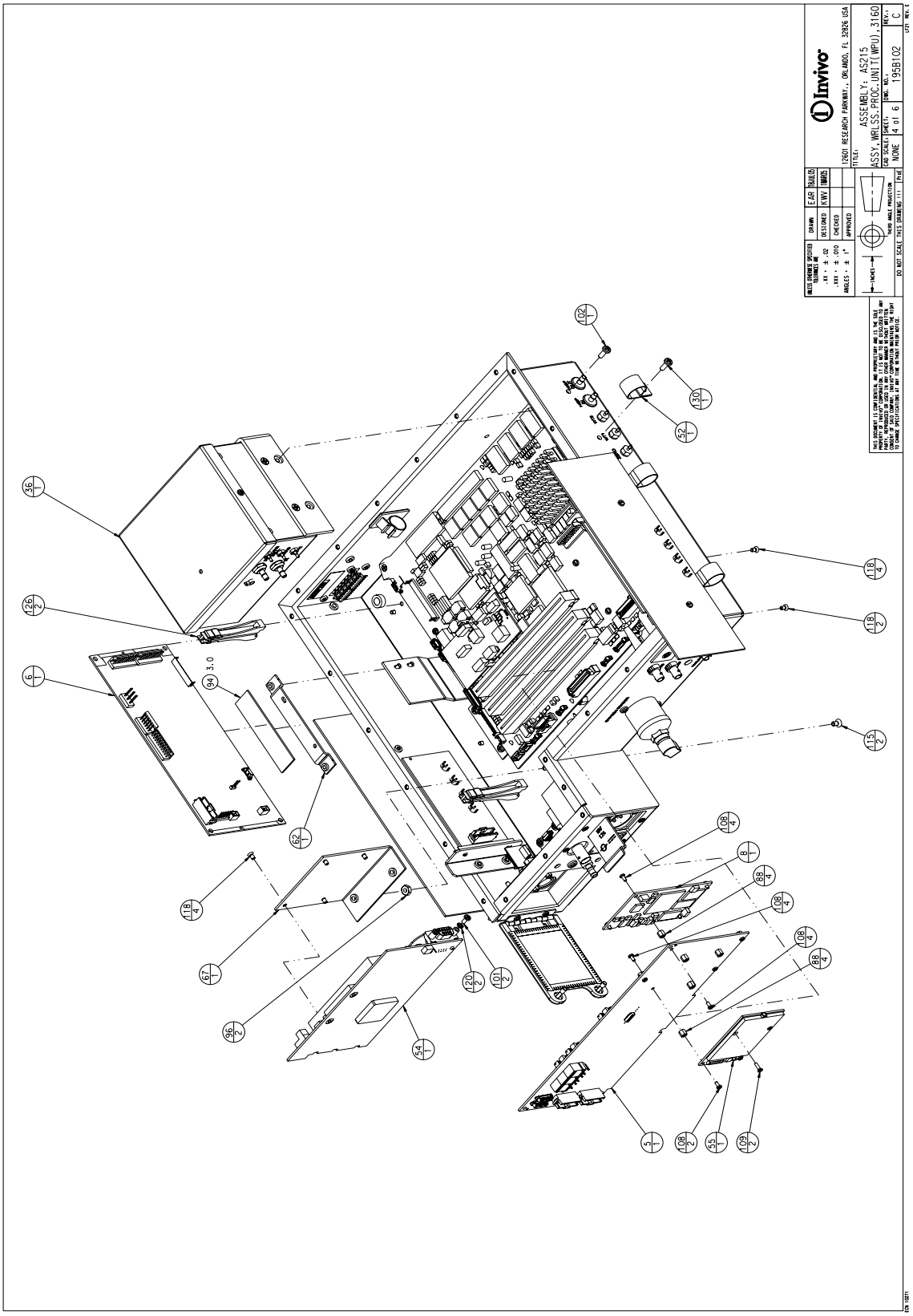
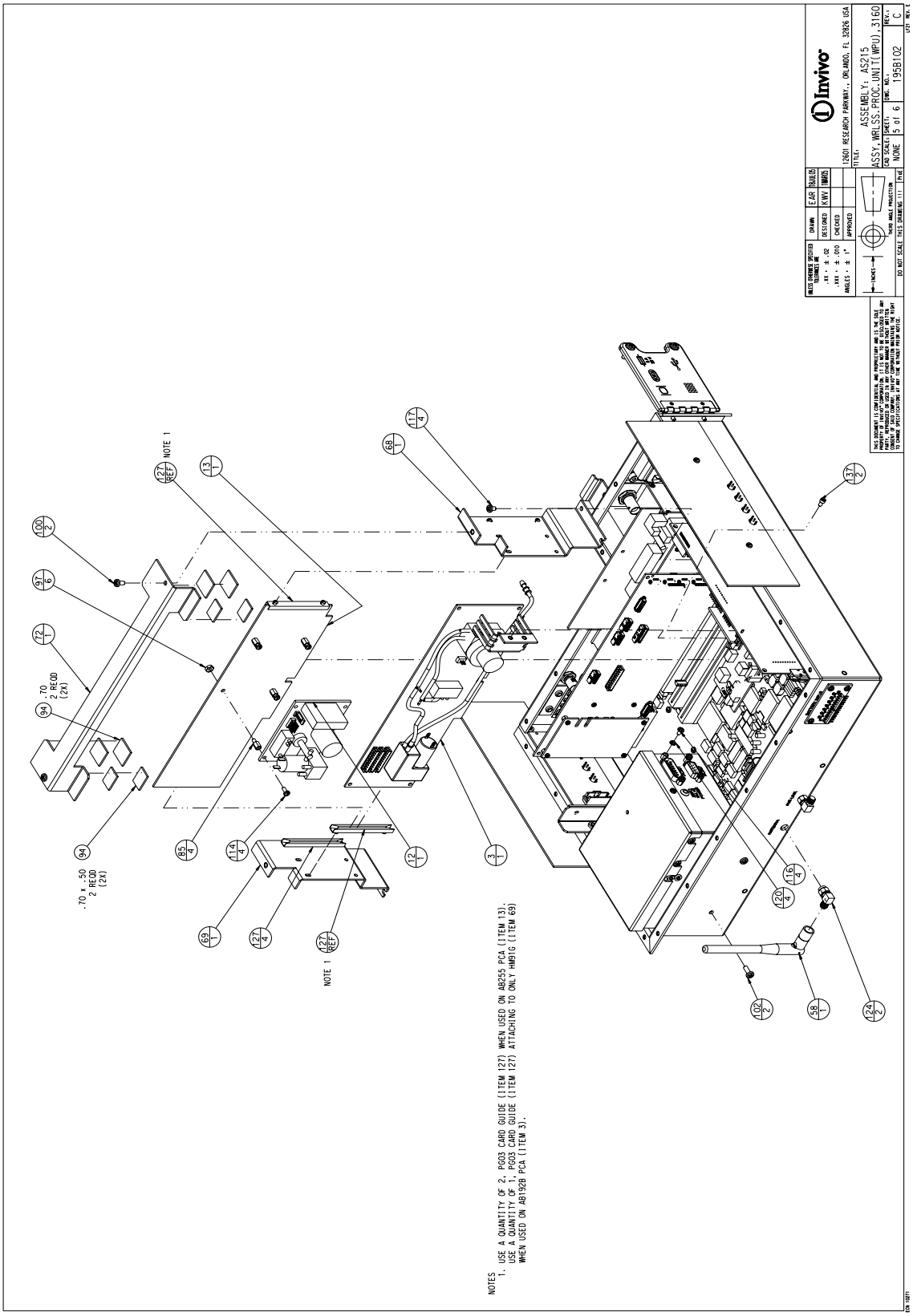
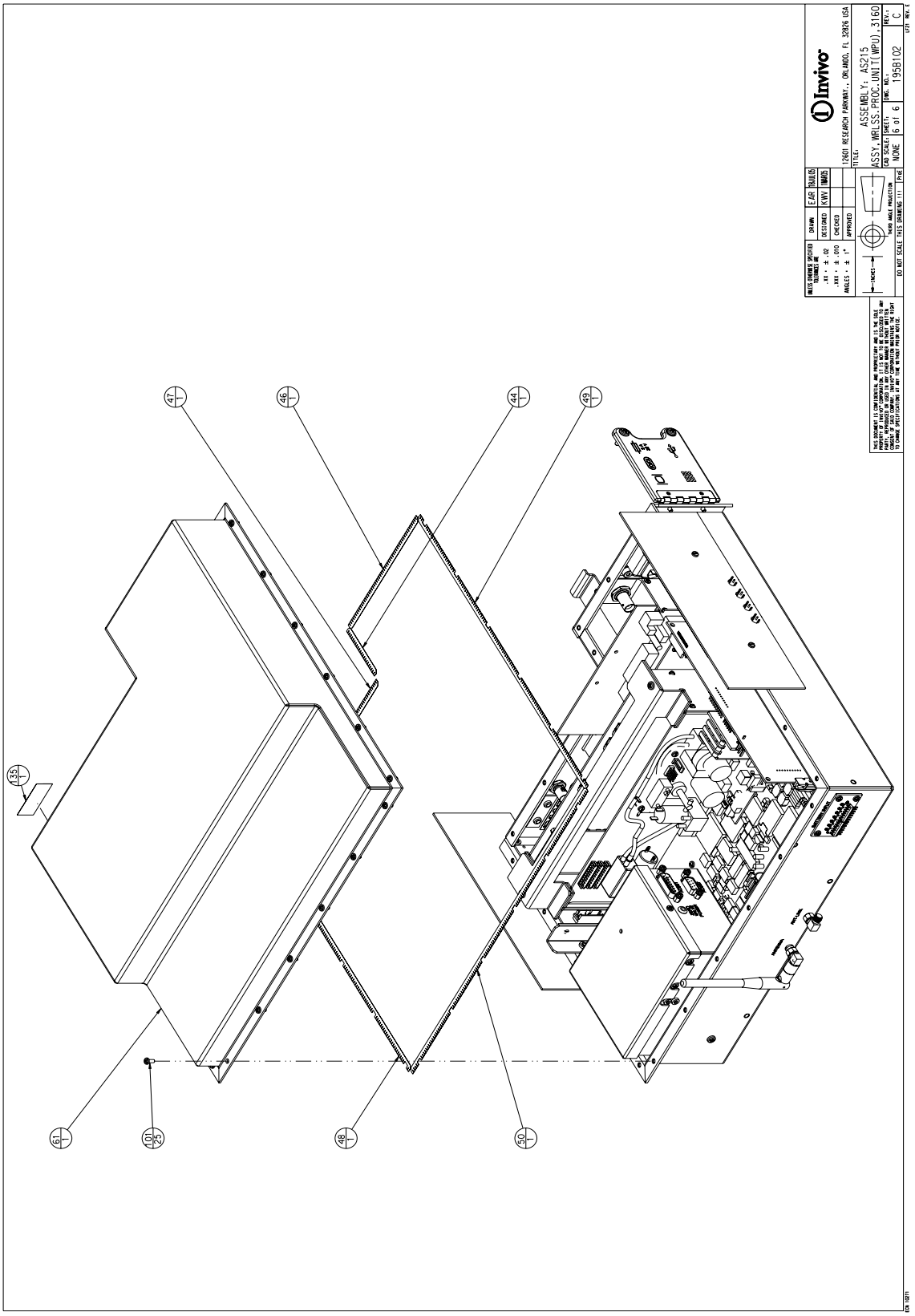
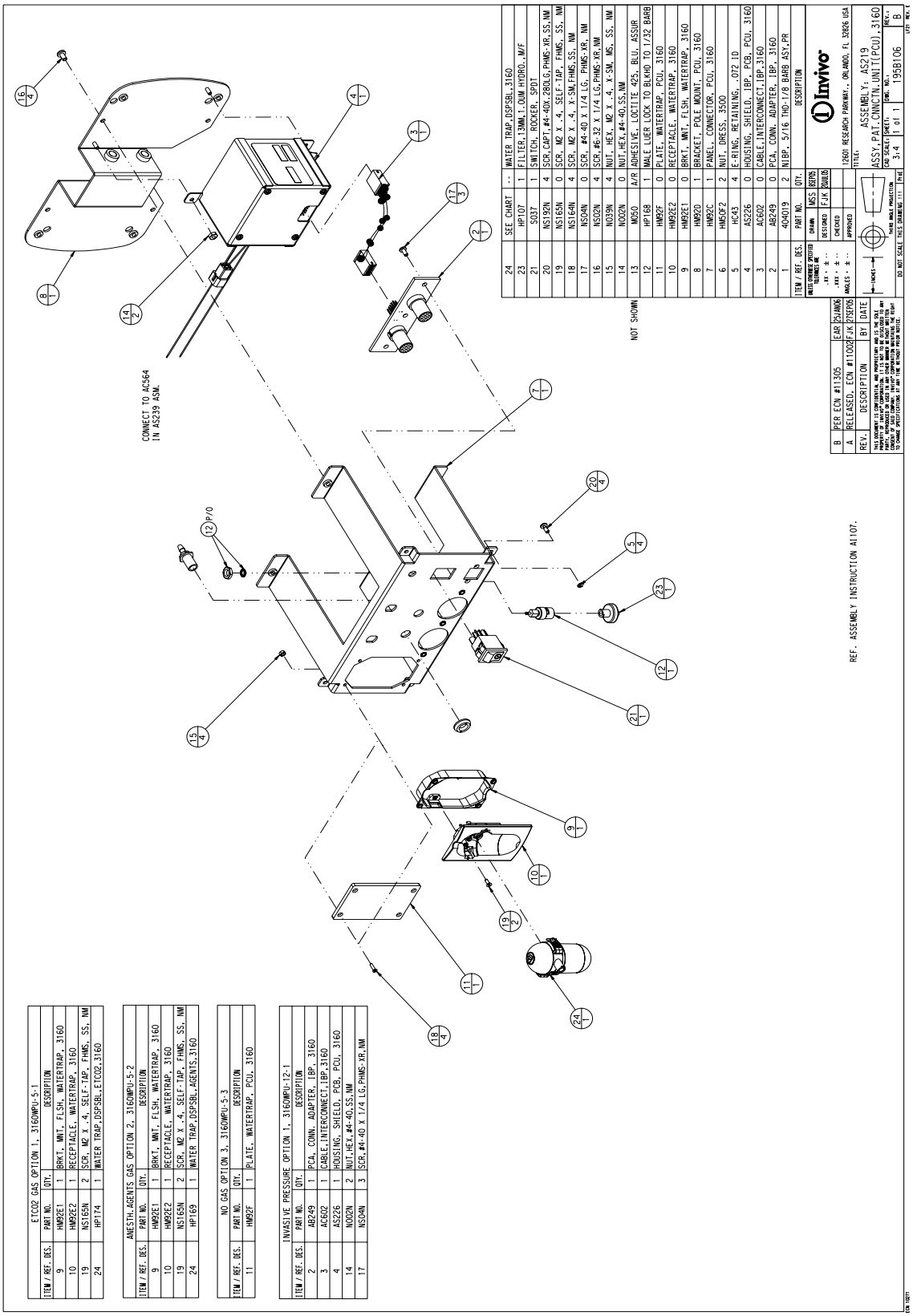
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
TITLE: ASSEMBLY, AS215
ASSY, WRLS, CS, PROC-UNIT (WPU), 3160
SIZE: C
DWG. NO.: 1958102
REV.: C
SCALE: NONE
SHEET: 3 of 6
DRAWN
DESIGNED
CHECKED
APPROVED
E.AR
K.WV
DO NOT SCALE THIS DRAWING
THIRD ANGLE PROJECTION


Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
TITLE: ASSEMBLY, AS215
ASSY, WRLS, CS, PROC-UNIT (WPU), 3160
SIZE: C
DWG. NO.: 1958102
REV.: C
SCALE: NONE
SHEET: 4 of 6
DRAWN
DESIGNED
CHECKED
APPROVED
E.AR
K.WV
MM/DD
DO NOT SCALE THIS DRAWING
THIRD ANGLE PROJECTION


NOTES
1. USE A QUANTITY OF 2, PG03 CARD GUIDE (ITEM 127) WHEN USED ON AB255 PCA (ITEM 13).
USE A QUANTITY OF 1, PG03 CARD GUIDE (ITEM 127) ATTACHING TO ONLY HM91G (ITEM 69)
WHEN USED ON AB192B PCA (ITEM 3).
NOTE 1
.70 x .50
2 REQD
(2X)
.70
2 REQD
(2X)
NOTE 1
Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
ASSY, WRLS, CS, PROC-UNIT (WPU), 3160
ASSEMBLY, AS215
195B102
C
5 of 6


Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
TITLE: ASSEMBLY, AS215
ASSY, WRLS, PROC-UNIT (WPU), 3160
SIZE: C
DWG. NO.: 195B102
REV.: C
SCALE: NONE
SHEET: 6 of 6
DRAWN: E.AR
DESIGNED: K.WV
CHECKED:
APPROVED:
DO NOT SCALE THIS DRAWING
47
46
44
49
35
61
100 125
48
50


ETCO2 GAS OPTION 1, 3160MPU-5-1
ITEM / REF. DES. | PART NO. | QTY. | DESCRIPTION
9 | HM92E1 | 1 | BRKT, MNT, FLSH, WATERTRAP, 3160
10 | HM92E2 | 1 | RECEPTIACLE, WATERTRAP, 3160
19 | NS165N | 2 | SCR, M2 X .4, SELF-TAP, FHMS, SS, NM
24 | HP174 | 1 | WATER TRAP,DSPSBL,ETCO2,3160
ANESTH.AGENTS GAS OPTION 2, 3160MPU-5-2
ITEM / REF. DES. | PART NO. | QTY. | DESCRIPTION
9 | HM92E1 | 1 | BRKT, MNT, FLSH, WATERTRAP, 3160
10 | HM92E2 | 1 | RECEPTIACLE, WATERTRAP, 3160
19 | NS165N | 2 | SCR, M2 X .4, SELF-TAP, FHMS, SS, NM
24 | HP169 | 1 | WATER TRAP,DSPSBL,AGENTS,3160
NO GAS OPTION 3, 3160MPU-5-3
ITEM / REF. DES. | PART NO. | QTY. | DESCRIPTION
11 | HM92F | 1 | PLATE, WATERTRAP, PCU, 3160
INVASIVE PRESSURE OPTION 1, 3160MPU-12-1
ITEM / REF. DES. | PART NO. | QTY. | DESCRIPTION
2 | AB249 | 1 | PCA, CONN, ADAPTER, IBP, 3160
3 | AC602 | 1 | CABLE,INTERCONNECT,IBP,3160
4 | AS226 | 1 | HOUSING, SHIELD, PCB, PCU, 3160
14 | NO02N | 2 | NUT,HEX,#4-40,SS,NM
17 | NS04N | 3 | SCR,#4-40 X 1/4 LG,PHMS-XR,NM
CONNECT TO AC564 IN AS239 ASM.
12 P/O
NOT SHOWN
24 | SEE CHART | -- | WATER TRAP,DSPSBL,3160
23 | HP107 | 1 | FILTER,13MM,1.0UM HYDRO.,W/F
21 | S037 | 1 | SWITCH, ROCKER, SPDT
20 | NS192N | 4 | SCR,CAPT,#4-40X.280LG,PHMS-XR,SS,NM
19 | NS165N | 0 | SCR, M2 X .4, SELF-TAP, FHMS, SS, NM
18 | NS164N | 4 | SCR, M2 X .4, X-SM,FHMS,SS, NM
17 | NS04N | 0 | SCR, #4-40 X 1/4 LG, PHMS-XR, NM
16 | NS02N | 4 | SCR,#6-32 X 1/4 LG,PHMS-XR,NM
15 | NO39N | 4 | NUT, HEX, M2 X .4, X-SM, MS, SS, NM
14 | NO02N | 0 | NUT,HEX,#4-40,SS,NM
13 | MO50 | A/R | ADHESIVE, LOCTITE 425, BLU, ASSUR
12 | HP168 | 1 | MALE LUER LOCK TO BLKHD TO 1/32 BARB
11 | HM92F | 0 | PLATE, WATERTRAP, PCU, 3160
10 | HM92E2 | 0 | RECEPTIACLE, WATERTRAP, 3160
9 | HM92E1 | 0 | BRKT, MNT, FLSH, WATERTRAP, 3160
8 | HM920 | 1 | BRACKET, POLE MOUNT, PCU, 3160
7 | HM92C | 1 | PANEL, CONNECTOR, PCU, 3160
6 | HM60F2 | 2 | NUT, DRESS, 3500
5 | HC43 | 4 | E-RING, RETAINING, .072 ID
4 | AS226 | 0 | HOUSING, SHIELD, IBP, PCB, PCU, 3160
3 | AC602 | 0 | CABLE,INTERCONNECT,IBP,3160
2 | AB249 | 0 | PCA, CONN, ADAPTER, IBP, 3160
1 | 4040419 | 2 | NIBP, 5/16 THD-1/8 BARB ASY,PR
ITEM / REF. DES. | PART NO. | QTY. | DESCRIPTION
B | PER ECN #11305 | EAR | 25JAN06
A | RELEASED, ECN #11002 | FJK | 25SEP05
REV. | DESCRIPTION | BY | DATE
DRAWN | MGS | 8SEP05
DESIGNED | FJK | 20AUG05
CHECKED
APPROVED
Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
TITLE: ASSEMBLY: AS219
ASSY,PAT.CONNCTN.UNIT(PCU),3160
CAD SCALE: 1/1 | SHEET: 1 OF 1 | DWG. NO.: 195B106 | REV.: B
3.4
DO NOT SCALE THIS DRAWING
REF. ASSEMBLY INSTRUCTION A1107.

ENGLISH LANGUAGE, 3160DCU-3-1			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101	1	OVERLAY, GRAPHICS, 3550

GERMAN LANGUAGE, 3160DCU-3-2			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101G	1	OVERLAY, GRAPHICS, 3550, GER

FRENCH LANGUAGE, 3160DCU-3-3			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101F	1	OVERLAY, GRAPHICS, 3550, FRN

SPANISH LANGUAGE, 3160DCU-3-4			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101S	1	OVERLAY, GRAPHICS, 3550, SPN

ITALIAN LANGUAGE, 3160DCU-3-5			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101I	1	OVERLAY, GRAPHICS, 3550, ITL

JAPANESE LANGUAGE, 3160DCU-3-6			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101J	1	OVERLAY, GRAPHICS, 3550, JPN

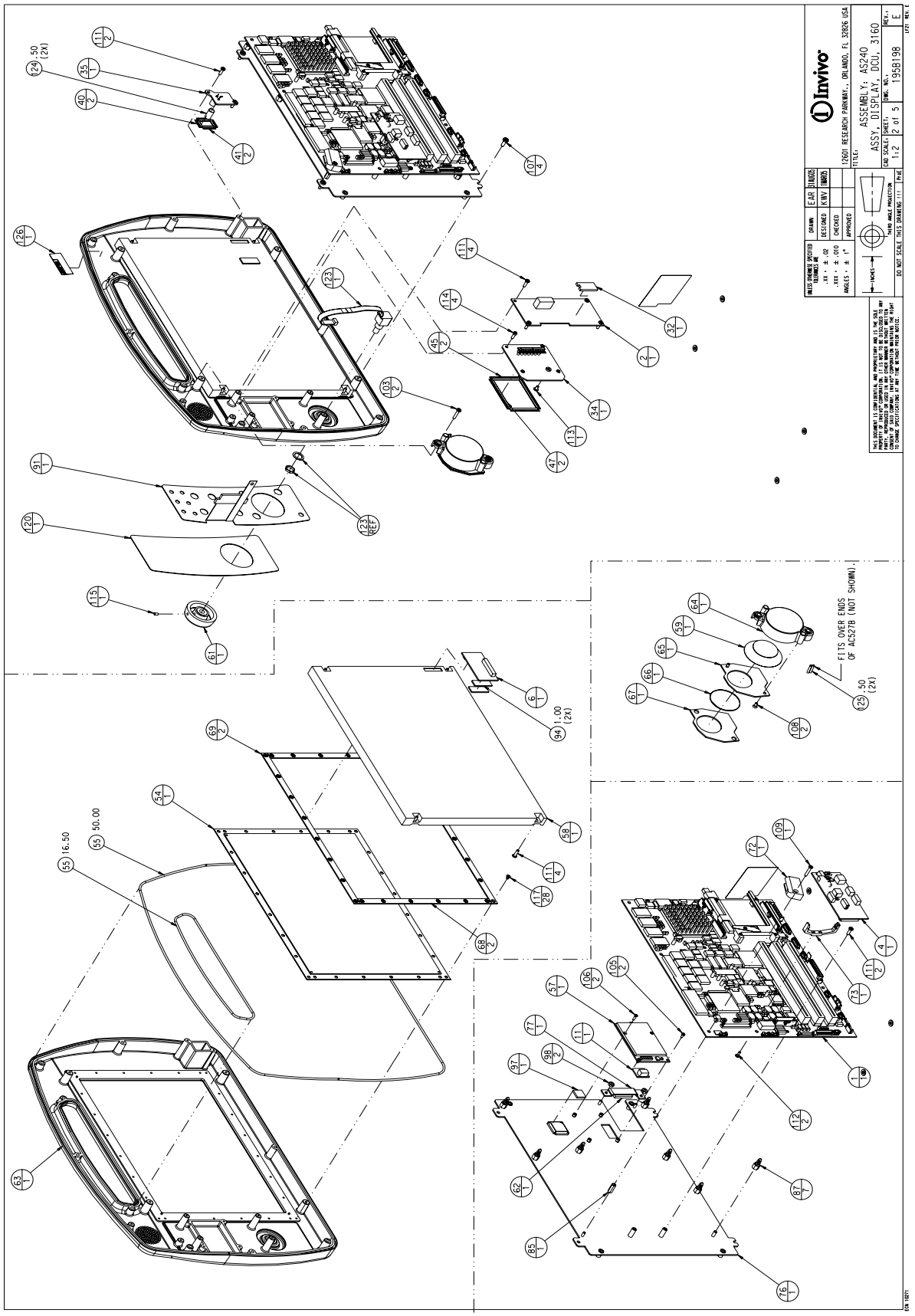
PORTUGUESE LANGUAGE, 3160DCU-3-7			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101P	1	OVERLAY, GRAPHICS, 3550, PRT

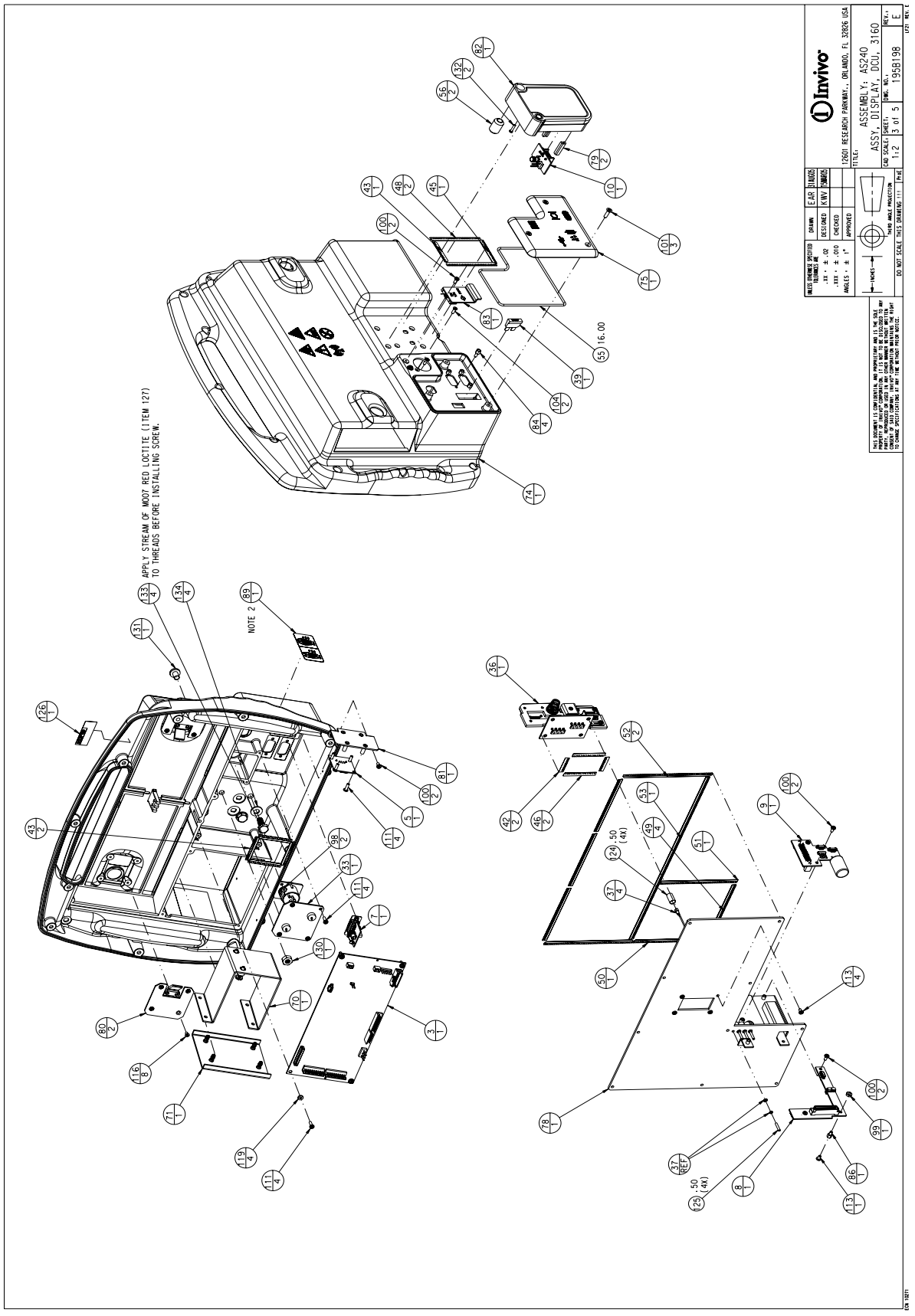
DANISH LANGUAGE, 3160DCU-3-8			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101D	1	OVERLAY, GRAPHICS, 3550, DAN

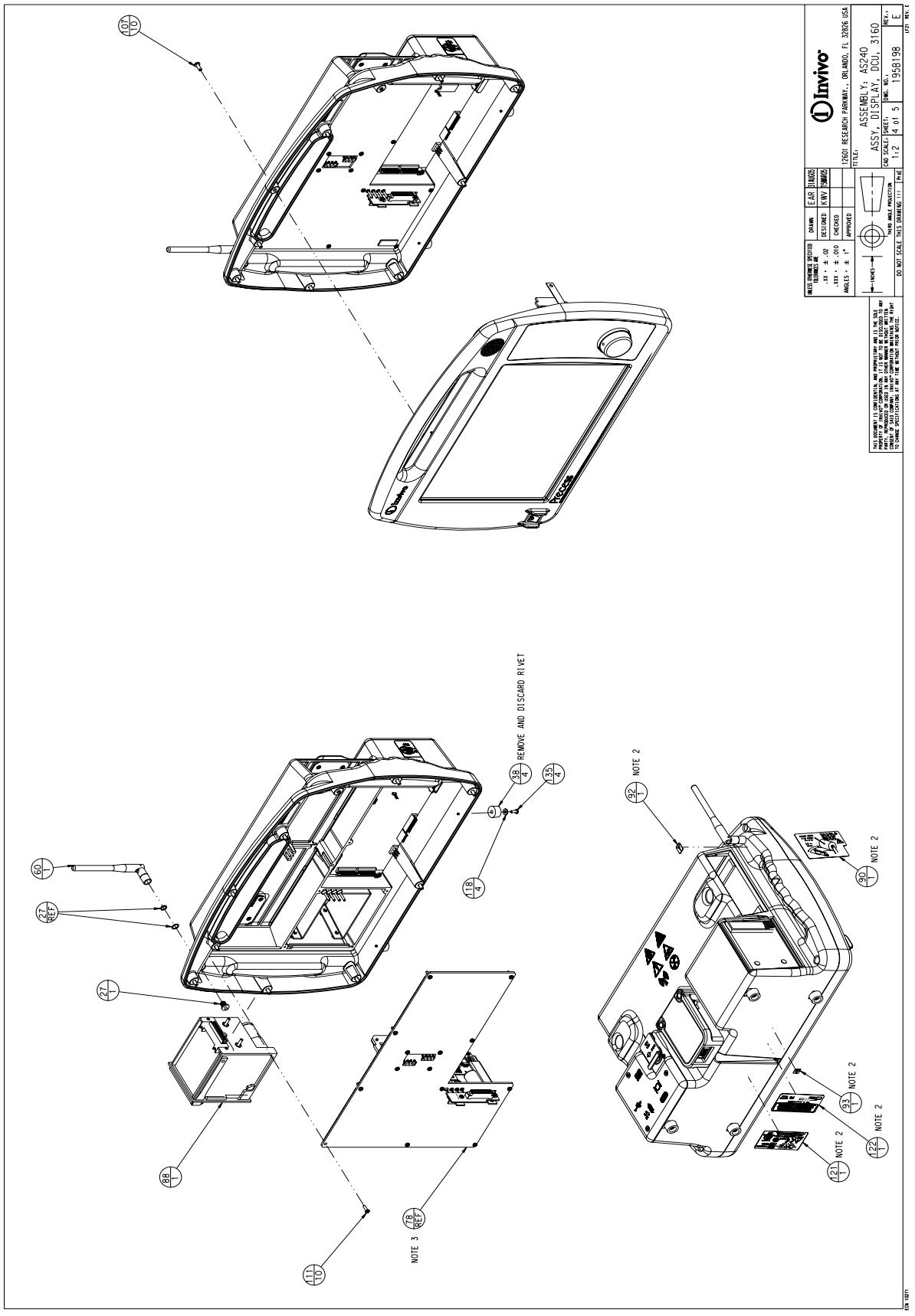
SWEDISH LANGUAGE, 3160DCU-3-9			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
120	L2101SW	1	OVERLAY, GRAPHICS, 3550, SWD

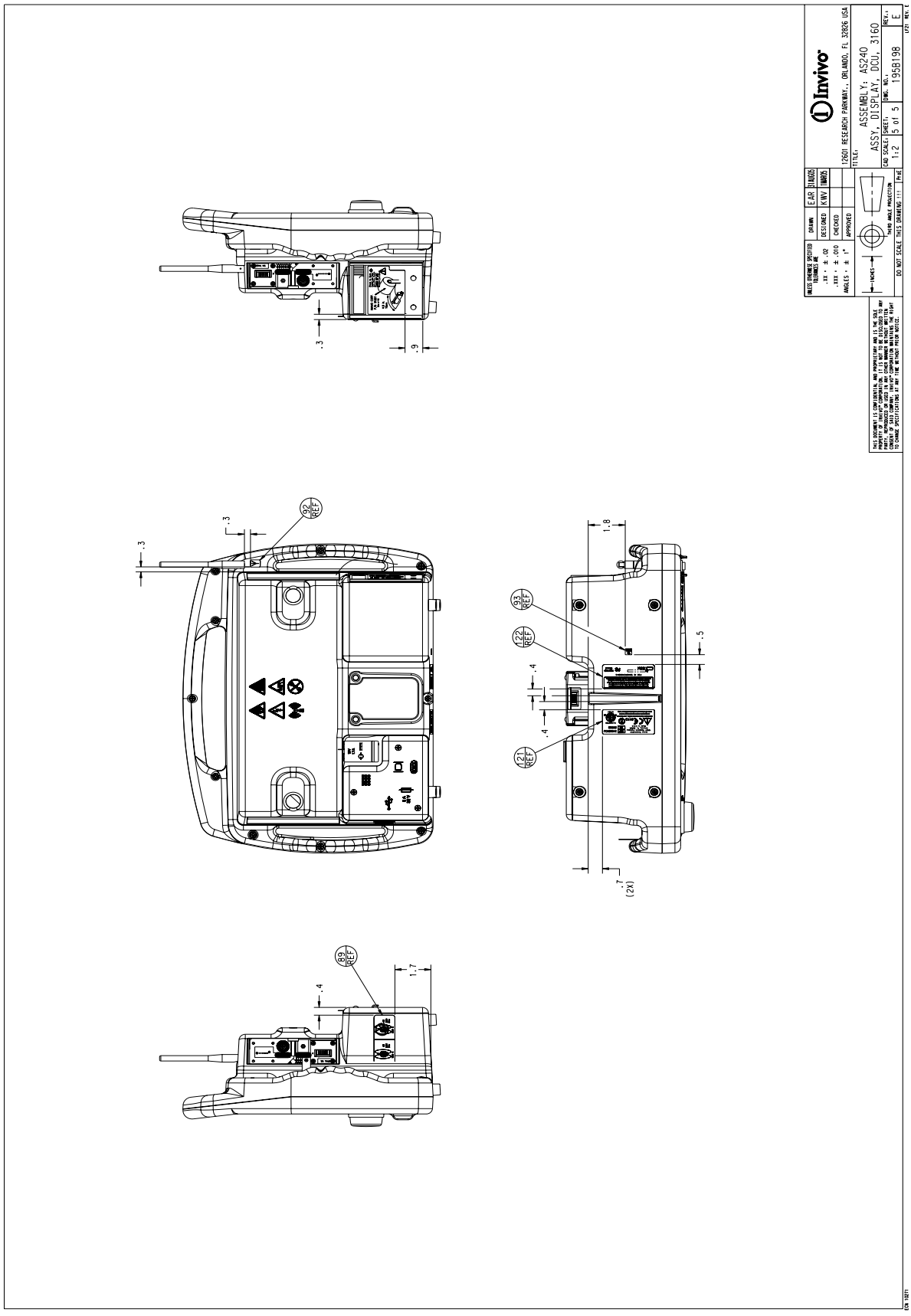
DUAL CHANNEL RECORDER, 3160DCU-4-1			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
88	HT18	1	RECRDER, BLACK, SERIAL
90	L2036A	1	LABEL,PRINTER DOOR,LT. GRAY

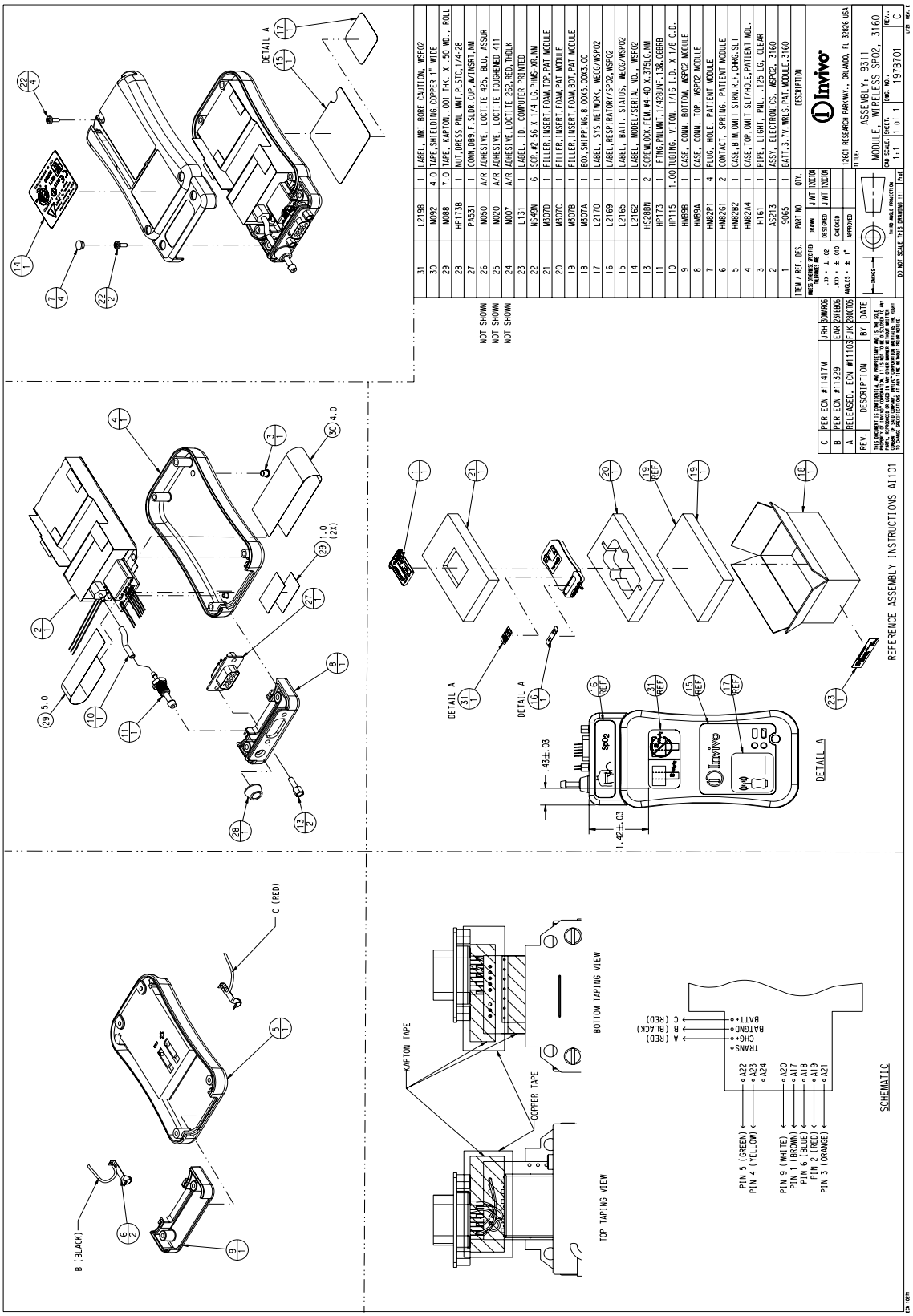
NO RECORDER, 3160DCU-4-2			
ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
70	HM90AF	1	BRKT, PRINTER COVER, DCU, 3160
71	HM90AG	1	COVER, PRINTER HOLE, DCU, 3160

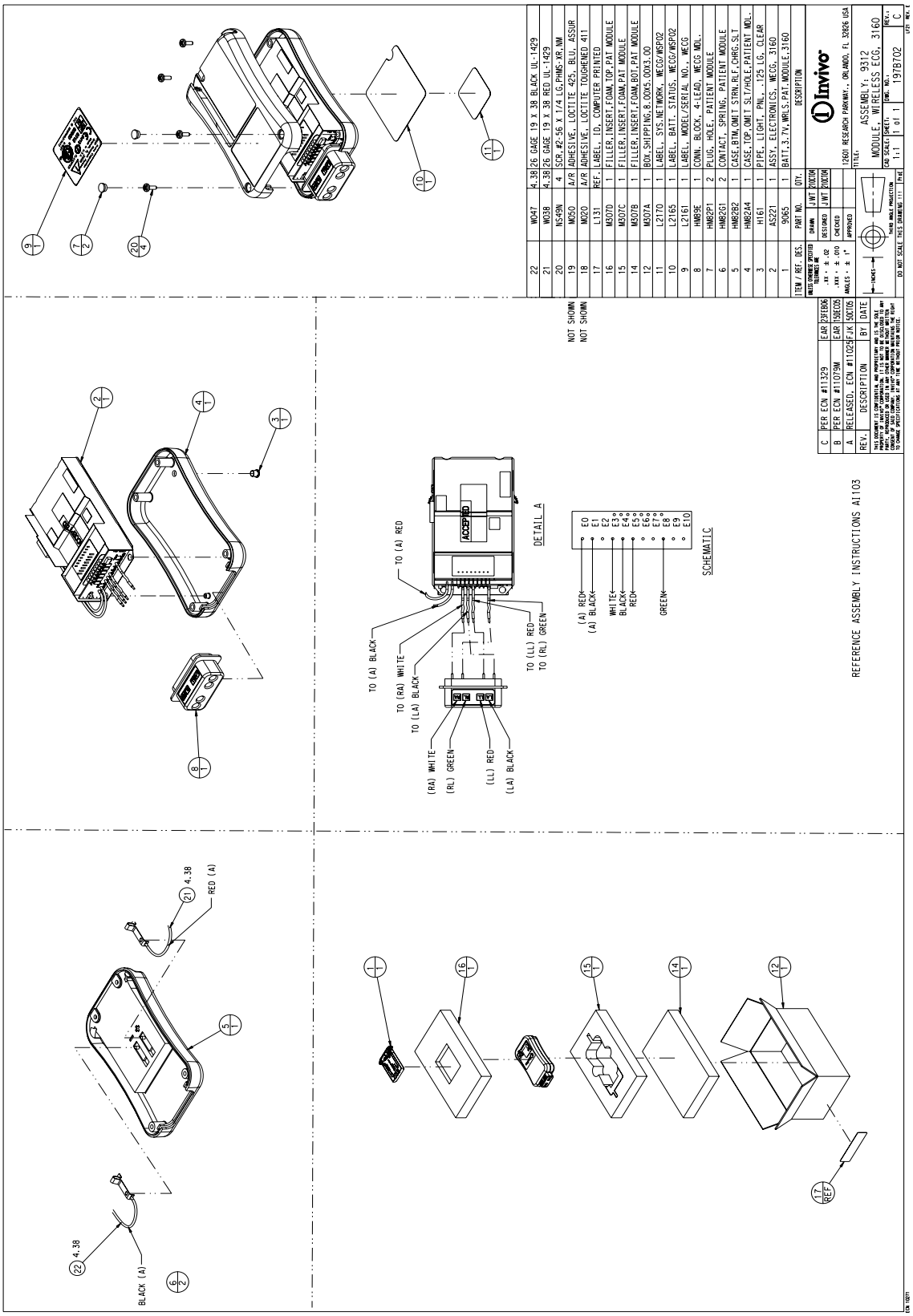

FITS OVER ENDS
OF AC527B (NOT SHOWN).
Invivo
12601 RESEARCH PARKWAY, ORLANDO, FL 32826 USA
TITLE: ASSEMBLY; AS240
ASSY, DISPLAY, DCU, 3160
DWG. NO. 195B198
REV. E
SHEET 2 of 5
CAD SCALE: 1:2
DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED
DRAWN
DESIGNED
CHECKED
APPROVED
E.AR
K.WV
MM/DD

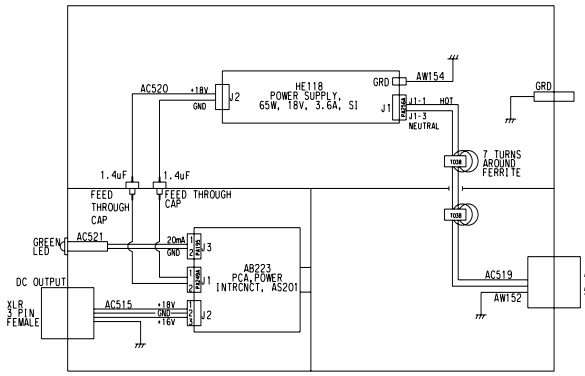

APPLY STREAM OF MOOT RED LOCTITE (ITEM 127)
TO THREADS BEFORE INSTALLING SCREW.
NOTE 2
16.00
Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
TITLE: ASSEMBLY; AS240
ASSY. DISPLAY, DCU, 3160
DWG. NO. 195B198
SHEET 3 of 5
CAD SCALE: 1:2
REV. E
DO NOT SCALE THIS DRAWING


REMOVE AND DISCARD RIVET
NOTE 2
NOTE 3
Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
TITLE: ASSEMBLY; AS240
ASSY. DISPLAY, DCU, 3160
DWG. NO. 195B198
REV. E
SHEET 4 of 5
CAD SCALE: 1:2
DRAWN E.AR
DESIGNED K.WV
CHECKED
APPROVED
DO NOT SCALE THIS DRAWING
MADE UNDER PRODUCTION

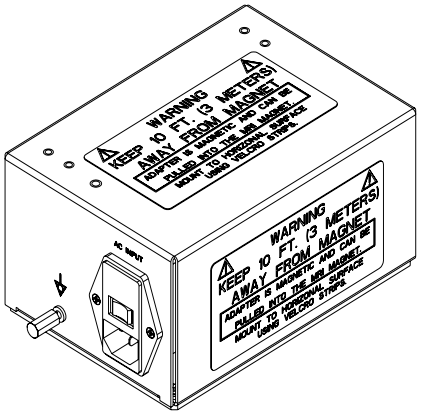

.3
.9
92 REF
.3
.3
1.8
93 REF
122 REF
.5
.4
.4
121 REF
.7
(2X)
88 REF
.4
1.7
Invivo
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
ASSEMBLY; AS240
ASSY. DISPLAY, DCU, 3160
195B198
E
DRAWN
DESIGNED
CHECKED
APPROVED
E.AR
K.WV
1:2
5 of 5
DO NOT SCALE THIS DRAWING


REFERENCE ASSEMBLY INSTRUCTIONS A1101
SCHEMATIC
TOP TAPING VIEW
BOTTOM TAPING VIEW
KAPTON TAPE
COPPER TAPE
DETAIL A
DETAIL A
DETAIL A
B (BLACK)
C (RED)
PIN 5 (GREEN)
PIN 4 (YELLOW)
PIN 9 (WHITE)
PIN 1 (BROWN)
PIN 6 (BLUE)
PIN 2 (RED)
PIN 3 (ORANGE)
A22
A23
A24
A20
A17
A18
A19
A21
TRANS
BATTGND
CHG
BATT
A (RED)
B (BLACK)
C (RED)
Invivo
ASSEMBLY, 9311
MODULE, WIRELESS, SPO2, 3160
1260 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
DESCRIPTION
QTY.
PART NO.
ITEM / REF. DES.
C PER ECN #114117M JRH 30MAR06
B PER ECN #11329 EAR 25FEB06
A RELEASED, ECN: #11103 FJK 28OCT05
REV. DESCRIPTION BY DATE
DO NOT SCALE THIS DRAWING
1 OF 1
197870 1
C
31 L2198 1 LABEL, MRI BORE CAUTION, WSPO2
30 M092 4.0 TAPE,SHIELDING,COPPER 1" WIDE
29 M088 7.0 TAPE, KAPTON, .001 THK. X .50 WD., ROLL
28 HP1738 1 NUT,DRESS,PNL MNT,PLSTC,1/4-28
27 PA531 1 CONN,DB9,F,SLDR,CUP W/INSRT,NM
26 M050 A/R ADHESIVE, LOCTITE 425, BLU, ASSUR
25 M020 A/R ADHESIVE, LOCTITE TOUGHENED 411
24 M007 A/R ADHESIVE,LOCTITE 262,RED,THDLK
23 L131 1 LABEL, ID, COMPUTER PRINTED
22 NS49N 6 SCR,#2-56 X 1/4 LG,PHMS,XR,NM
21 M307D 1 FILLER,INSERT,FOAM,TOP,PAT MODULE
20 M307C 1 FILLER,INSERT,FOAM,PAT MODULE
19 M307B 1 FILLER,INSERT,FOAM,BOT,PAT MODULE
18 M307A 1 BOX,SHIPPING,8.00X5.00X3.00
17 L2170 1 LABEL, SYS,NETWORK, WEGO/WSPO2
16 L2169 1 LABEL,RESPIRATORY/SPO2,WSPO2
15 L2165 1 LABEL, BATT. STATUS, WEGO/WSPO2
14 L2162 1 LABEL, MODEL/SERIAL NO., WSPO2
13 HS288N 2 SCREWLOCK,FEN,#4-40 X.375LG,NM
11 HP173 1 FTNG,PNLMNT,1/4ZBUNF.13B,OBRB
10 HP115 1.00 TUBING, VITON, 1/16 I.D. X 1/8 O.D.
9 HM898 1 CASE, CONN, BOTTOM, WSPO2 MODULE
8 HM894 1 CASE, CONN, TOP, WSPO2 MODULE
7 HM6291 4 PLUG, HOLE, PATIENT MODULE
6 HM6261 2 CONTACT, SPRING, PATIENT MODULE
5 HM6282 1 CASE,BTM,OMIT STRN.RLF,CHRG.SLT
4 HM6244 1 CASE,TOP,OMIT SLT/HOLE,PATIENT MDL.
3 H161 1 PIPE, LIGHT, PNL, .125 LG, CLEAR
2 AS213 1 ASSY, ELECTRONICS, WSPO2, 3160
1 9065 1 BATT,3.7V,WRLS,PAT MODULE,3160
DRAWN JWT 20OCT00
DESIGNED JWT 20OCT00
CHECKED
APPROVED
SHEET 1 OF 1
SIZE C
DWG. NO. 197870
REV. C
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
.XX = ± .02
.XXX = ± .010
ANGLES = ± 1°
THIRD ANGLE PROJECTION
DO NOT SCALE THIS DRAWING
THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY AND IS THE REAL PROPERTY OF INVIVO CORPORATION. IT IS NOT TO BE DISCLOSED TO ANY PERSON OR ENTITY WITHOUT THE WRITTEN CONSENT OF INVIVO CORPORATION. REPRODUCTION OF THIS DRAWING IN WHOLE OR IN PART IS PROHIBITED. ANY USE OF THIS DRAWING OTHER THAN TO MANUFACTURE INVIVO CORPORATION MATERIAL MAY BE IN VIOLATION OF SAID COMPANY'S RIGHTS. BY ACCEPTANCE OF THIS DRAWING YOU AGREE TO THESE RESTRICTIONS AND TO HONOR SPECIFICATIONS AS SET FORTH HEREIN.


REFERENCE ASSEMBLY INSTRUCTIONS A1103
DETAIL A
SCHEMATIC
TO (A) RED
TO (A) BLACK
TO (RA) WHITE
TO (LA) BLACK
TO (LL) RED
TO (RL) GREEN
(RA) WHITE
(RL) GREEN
(LL) RED
(LA) BLACK
(A) RED
(A) BLACK
WHITE
BLACK
RED
GREEN
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
4.38
RED (A)
BLACK (A)
Invivo
ASSEMBLY, 9312
MODULE, WIRELESS ECG, 3160
12601 RESEARCH PARKWAY., ORLANDO, FL 32826 USA
DESCRIPTION
PART NO.
QTY.
ITEM / REF. DES.
22 W047 4.38 26 GAGE 19 X 38 BLACK UL-1429
21 W038 4.38 26 GAGE 19 X 38 RED UL-1429
20 NS49N 4 SCR.#2-56 X 1/4 LG.PHMS-XR.NM
19 M050 A/R ADHESIVE, LOCTITE 425, BLU. ASSUR
18 M020 A/R ADHESIVE, LOCTITE 7000HEMED 411
17 L131 REF. LABEL, ID, COMPUTER PRINTED
16 M307D 1 FILLER,INSERT,FOAM,TOP,PAT MODULE
15 M307C 1 FILLER,INSERT,FOAM,PAT MODULE
14 M307B 1 FILLER,INSERT,FOAM,BOT,PAT MODULE
12 M307A 1 BOX,SHIPPING,8.00X5.00X3.00
11 L2170 1 LABEL, SYS.NETWORK, MCG/WSP02
10 L2165 1 LABEL, BATT. STATUS, MCG/WSP02
9 L2161 1 LABEL, MODEL/SERIAL NO., MCG
8 HM85E 1 CONN. BLOCK, 4-LEAD, MCG MDL.
7 HM62P1 2 PLUG, HOLE, PATIENT MODULE
6 HM62G1 2 CONTACT, SPRING, PATIENT MODULE
5 HM62B2 1 CASE,BTM,OMIT STRN.RLF,CHRG.SLT
4 HM62A4 1 CASE,TOP,OMIT SLT/HOLE,PATIENT MDL.
3 H161 1 PIPE, LIGHT, PNL, .125 LG, CLEAR
2 AS221 1 ASSY, ELECTRONICS, MCG, 3160
1 9065 1 BATT,3.7V,WRLS,PAT.MODULE,3160
C PER ECN #11329 EAR 25FE06
B PER ECN #110790 EAR 15DEC05
A RELEASED, ECN #11025 FJK 15OCT05
REV. DESCRIPTION BY DATE
DRAWN JWT 20OCT04
DESIGNED JWT 20OCT04
CHECKED
APPROVED
SIZE A
SCALE 1:1
SHEET 1 of 1
DWG. NO. 197B702
REV. C



INTERCONNECT DIAGRAM


WARNING
KEEP 10 METERS (3 FT.) AWAY FROM MAGNET
ADAPTER IS MAGNETIC AND CAN BE PULLED INTO THE MRI MAGNET.
MOUNT TO HORIZONTAL SURFACE USING VELCRO STRIPS.
AC INPUT

NOTES

1. INSTALL HC28 GROMMET (ITEM 10) IN HOLE INSIDE HM87A POWER ADAPTER BOX (ITEM 14). AFFIX L2181 LABEL (ITEM 46) ONTO APPROXIMATE AREA SHOWN (DETAIL A, SHEET 2). PLACEMENT SHOULD BE VISIBLE NEXT TO BOX GROUND STUD AT BASE OF COMPARTMENT.
2. ROUTE WIRES/TERMINALS OF AC521 CABLE (ITEM 5) THROUGH "DC OUTPUT HOLE" OF POWER ADAPTER BOX AND APPLY PRESSURE TO THE LED UNTIL IT IS LOCKED IN PLACE. INSERT RED WIRE INTO PIN 1 OF PA195 CONNECTOR (ITEM 39) AND THE WHITE WIRE IN PIN 2.
3. PLACE TWO H101 INSULATORS (ITEM 13) BEHIND REGULATOR ON AB223 INTERCONNECT PCA (ITEM 1) AND LOOSELY SECURE TO WALL USING NS01 NYLON SCREW (ITEM 31).
4. USING TWO NW44N WASHERS (ITEM 38) AND TWO NS04N SCREWS (ITEM 45), FASTEN THE INTERCONNECT ASSY TO THE STANDOFFS PROVIDED.
5. USING A NW40N WASHER (ITEM 36) AND A NO03N HEX NUT (ITEM 29), SECURE AW152 GROUND WIRE (ITEM 43) TO THREADED INSERT IN THE LINE FILTER CAVITY PORTION OF THE CABINET.
6. USING A NW40N WASHER, AND A NO03N HEX NUT, SECURE AW154 GROUND WIRE (ITEM 6) TO THREADED INSERT FOUND IN POWER SUPPLY CAVITY.
7. REMOVE ANY HARDWARE ON FEED-THRU CAPS MOUNTED TO AC520 DC OUTPUT ASSY (ITEM 4) AND SET ASIDE FOR LATER USE. RUN WIRES (RED THRU TOP/BLK THRU BOTTOM) CONNECTED TO FEED-THRU CAPS THROUGH HOLES IN WALL AND SECURE IN PLACE USING PREVIOUSLY REMOVED HARDWARE.
8. ROUTE WIRES TOWARDS BOTTOM OF CAVITY AND ORIENT PA249A CONNECTOR (ITEM 40) SUCH THAT THE TERMINAL ON THE RED WIRE CAN BE INSERTED INTO POSITION 1 AND THE BLK WIRE INTO POSITION 2.
9. POSITION T038 TOROIDAL CORE (ITEM 42) ON OTHER SIDE OF CABINET WALL AND INSERT THE BLACK AND WHITE WIRES OF AC519 MAIN POWER INPUT ASSY (ITEM 3) THRU THE EXTERIOR CABINET WALL, THRU THE INTERIOR WALL, AND THEN THRU THE TOROIDAL CORE. SNAP AC FILTER INTO POSITION.
10. WRAP BLACK AND WHITE WIRES AROUND CORE SEVEN TIMES. ONCE COMPLETED, GRASP PA456A CONNECTOR (ITEM 41) AND INSERT BLACK WIRE WITH TERMINAL INTO THE #1 POSITION. INSERT THE WHITE WIRE INTO POSITION #3.
11. PLUG TERMINAL FROM PREVIOUSLY INSTALLED AW152 GROUND WIRE INTO THE GND TERMINAL FOUND AT THE TOP OF THE AC FILTER. FASTEN THE AC FILTER TO THE CABINET USING TWO NS98N SCREWS (ITEM 34).
12. ORIENT AC515 DC POWER OUTPUT CABLE (ITEM 2) THROUGH CABINET HOLE AND MOUNT METAL CONNECTOR TO STUDS PROVIDED ON CABINET. ORIENT THE GROUND WIRE TO THE UPPER MOST STUD AND FASTEN IT IN PLACE USING A NW44N WASHER AND NO29 HEX NUT (ITEM 28). USE SAME HARDWARE TO SECURE CONNECTOR TO REMAINING POST.
13. MOUNT CONNECTOR ON AC515 TO LOWER CONNECTOR (J2) OF POWER INTERCONNECT PCA. MOUNT CONNECTOR FROM FEED THRU CAPS TO (J1) CONNECTOR OF POWER INTERCONNECT PCA. MOUNT LED CONNECTOR TO FINAL CONNECTOR (J3).
14. APPLY 2 INCH LONG M267A BLACK THERMAL PAD (ITEM 24) TO HM87C POWER ADAPTER BRACKET (ITEM 16) AND ALIGN HOLES OF THERMAL PAD TO BRACKET.
15. APPLY 1 INCH M223C THERMAL PAD (ITEM 23) TO LOWER HEAT SINK ON HE118 POWER SUPPLY PCA (ITEM 11).
16. ORIENT POWER SUPPLY PCA TO POWER ADAPTER BRACKET. SECURE POWER SUPPLY PCA TO BRACKET USING TWO NW44N SPLIT LOCK WASHERS AND TWO NS26N SCREWS (ITEM 32).
17. ORIENT TWO NS52 NYLON SCREWS (ITEM 33) WITH NW21 NYLON WASHER (ITEM 35) FOR INSERTION INTO THE POWER SUPPLY BRACKET. SECURE TO HEAT SINK ON POWER SUPPLY PCA USING NW21 NYLON WASHER AND NO28 NYLON HEX NUT (ITEM 30).
18. ORIENT POWER SUPPLY BRACKET/POWER SUPPLY PCA ASSEMBLY SUCH THAT THE BOTTOM OF THE BRACKET MOUNTED TO THE CABINET IS UPRIGHT. APPLY M014 HEAT SINK THERMAL-COTE (ITEM 44) TO THE ENTIRE BOTTOM SURFACE OF THE BRACKET.
19. ORIENT ASSEMBLY TO CABINET (BRACKET TOWARDS INTERIOR WALL) POSTS AND SECURE IN PLACE USING FOUR NW43N SPLIT-LOC WASHERS (ITEM 37) AND FOUR NO01N HEX NUTS (ITEM 27).
20. FASTEN AC520 CONNECTOR TO J2 ON POWER SUPPLY PCA. FASTEN AW154 GROUND WIRE TO GROUND CLIP ON PCA. SECURE CONNECTOR FROM TOROIDAL CORE TO J1 ON POWER SUPPLY PCA.
21. INSTALL HE16 BINDING POST (ITEM 12) TO CABINET USING HARDWARE PROVIDED WITH POST. USE LOCTITE SPARINGLY.
22. ROUTE TO INSPECTION.
23. ROUTE TO TEST FOR ALIGNMENT.
24. ORIENT HM87B POWER ADAPTER COVER AND INSTALL HM87B POWER ADAPTER COVER (ITEM 15) AND INSTALL H158 AND H159 RF PANEL STRIP GASKETS (ITEM 8 AND ITEM 9, RESPECTIVELY) PER PRINT.
25. ATTACH H155 EMI U-CHANNEL GASKET (ITEM 7) TO CABINET WALLS PER PRINT.
26. FASTEN COVER TO CABINET USING FOURTEEN NS98N SCREWS. USE LOCTITE SPARINGLY.
27. USING DIMENSIONS GIVEN ON PRINT, APPLY L2153 WARNING LABELS (ITEM 21) TO CABINET.
28. APPLY REMAINING LABELS PER PRINT DIRECTION.
29. APPLY M032 LOOP FASTENERS (ITEM 26) TO COVER WHERE INDICATED. PLACE MATCHING M031 LOOP COVERS (ITEM 25) OVER M032 LOOP FASTENERS - LEAVE STRIP IN PLACE.
30. ROUTE TO INSPECTION.

ITEM / REF. DES.	PART NO.	QTY.	DESCRIPTION
46	L2181	1	LABEL, PROTECTIVE EARTH GROUND
45	NS04N	2	SCR, #4-40 X 1/4 LG, PHMS-XR, NM
(NOT SHOWN) 44	M014	A/R	COMPOUND,HEAT SINK THRM JOINT
43	AW152	1	WIRE,GROUND,LINE FILTER,3550
42	T038	1	CORE,TOROIDAL,FERRITE
41	PA456A	1	CONN,3P,SR,HSG,LKG,.156 CTRS.
40	PA249A	1	CONN,2P,SR,HSG,.156 CTRS
39	PA195	1	CONN,2P,SR,HSG,ST,.098 CTRS.
38	NW44N	6	WSHR,LCK,SPLT,#4,SS,NM
37	NW43N	4	WSHR,LCK,SPLT,#6,SS,NM
36	NW40N	2	WSHR,LCK,SPLT,#8,SS,NM
35	NW21	4	WSHR, NYLON, #6
34	NS98N	16	SCR, #4-40 X 1/4 LG, FHMS-XR, NM
33	NS51	2	SCR,#6-32 X 3/4LG.PHMS-NY
32	NS26N	2	SCR,#4-40 X 3/8 LG.PHMS-XR,NM
31	NS01	1	SCR,#6-32 X 3/8 LG,PHMS-XR,NY.
30	NO28	2	NUT,HEX,#6-32,NY
29	NO03N	2	NUT,HEX,#8-32,SS,NM
28	NO29	2	NUT, #4-40 HEX-SS, NM
27	NO01N	4	NUT,HEX,#6-32,SS,NM
26	M032	8.0	FASTENER,LOOP,BLACK,1" WIDE
25	M031	8.0	FASTENER,HOOK,BLACK,1" WIDE
24	M267A	1	PAD, BLACK, THERMAL, 2.0 X 1.2 X .08
23	M223C	1	PAD, THERMAL, 1.0 X 1.0 X .08
(NOT SHOWN) 22	M050	A/R	ADHESIVE, LOCTITE 425, BLU, ASSUR
21	L2153	3	LBL, WARNING, AC ADAPTER, MRI
20	L2149	1	LBL,INPUT VOLT,AC ADAPTER,AS201,MRI
19	L2148	1	LBL,PRODUCT I.D,AC ADAPTER,AS201,MRI
18	L185	1	LABEL, DATE OF MANUFACTURE
17	L137A	1	LABEL, C.E. COMPLIANCE, MOD (SEMKO)
16	HM87C	1	BRKT,PCA,POWER ADAPTER,MRI
15	HM87B	1	COVER, POWER ADAPTER, MRI
14	HM87A	1	BOX, POWER ADAPTER, MRI
13	H101	2	INSULATOR,THERMALLY CONDUCTIVE
12	HE16	1	BINDING POST,METAL
11	HE118	1	POWER SUPPLY, 65W, 18V, 3.6A, SI
10	HC28	1	GRMT,5/16 ID.X 7/16MH.X 1/16GV
9	H159	2	STRIP,RF,PNL.GSKT,.23 X 6.460L
8	H158	2	STRIP,RF,PNL.GSKT,.23 X 3.895L
7	H155	1	GSKT,EMI,U-CHNL,.150W X .30
6	AW154	1	WIRE,GROUND,POWER SUPPLY,3550
5	AC521	1	CAB, LED, POWER INDICATOR, AS201
4	AC520	1	CAB, DC OUTPUT, FLTR, AS201
3	AC519	1	CAB, INPUT, MAIN POWER, AS201
2	AC515	1	CAB, DC POWER, OUTPUT, AS201
1	AB223	1	PCA,POWER INTRCNCT,AS201,3155 SERIES

REV.	DESCRIPTION	BY	DATE
F	PER ECN #11248	JRH	21DEC05
E	PER ECN #10762M	JRH	7JUL05
D	PER ECN #10556	FJK	5MAY05
C	PER ECN #10408	EAR	11MAR05
B	PER ECN #10161	FJK	15NOV04
A	RELEASED, ECN #10075	FJK	3AUG04

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THIRD ANGLE PROJECTION

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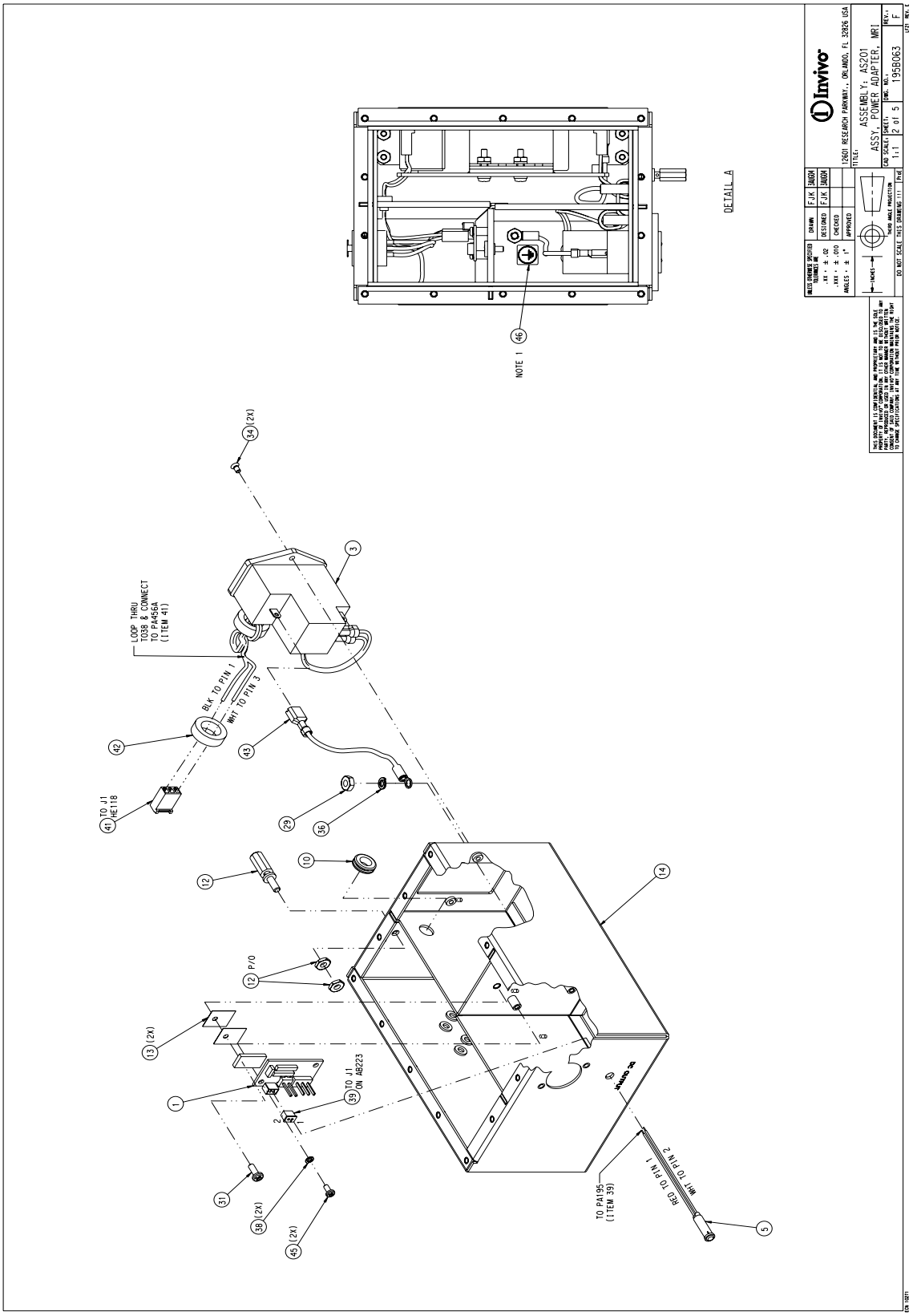
TITLE:
ASSEMBLY: AS201
ASSY, POWER ADAPTER, MRI

CAD SCALE:	SHEET:	DWG. NO.	REV.:
1:1	1 of 5	195B063	F

ECN 10211 LF21 REV. E


DETAIL A
NOTE 1
LOOP THRU TO3B & CONNECT TO PA456A (ITEM 41)
BLK TO PIN 1
WHT TO PIN 3
TO J1 PE118
P/O
TO J1 ON AB223
TO PA195 (ITEM 39)
RED TO PIN 1
WHT TO PIN 2
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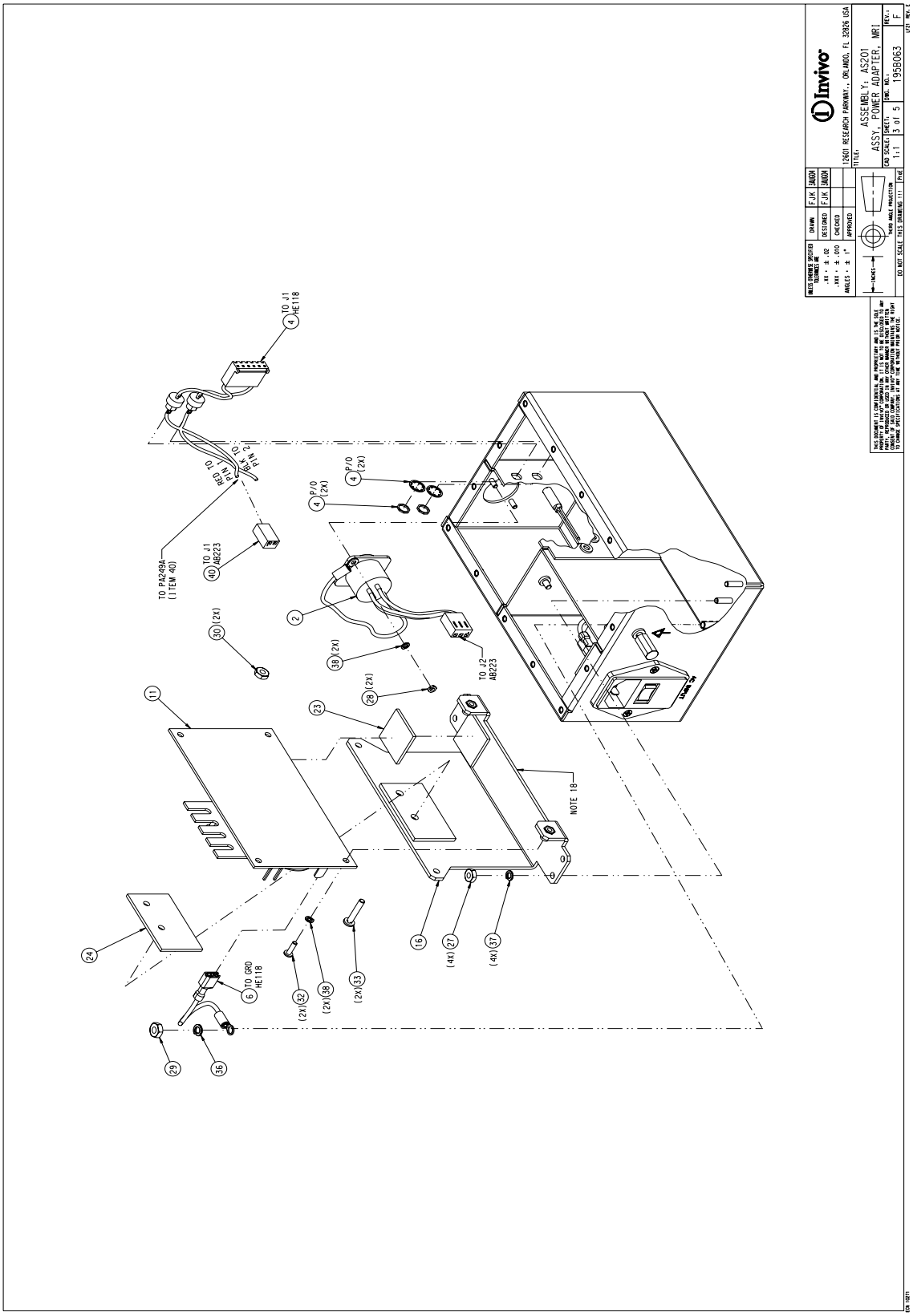
1958063


TO J1
HE118
RED TO PIN 2
BLK TO PIN 1
TO PA249A
(ITEM 40)
TO J1
AB223
P/O
(2X)
TO J2
AB223
NOTE 18
TO GRD
HE118
(4X)
(2X)
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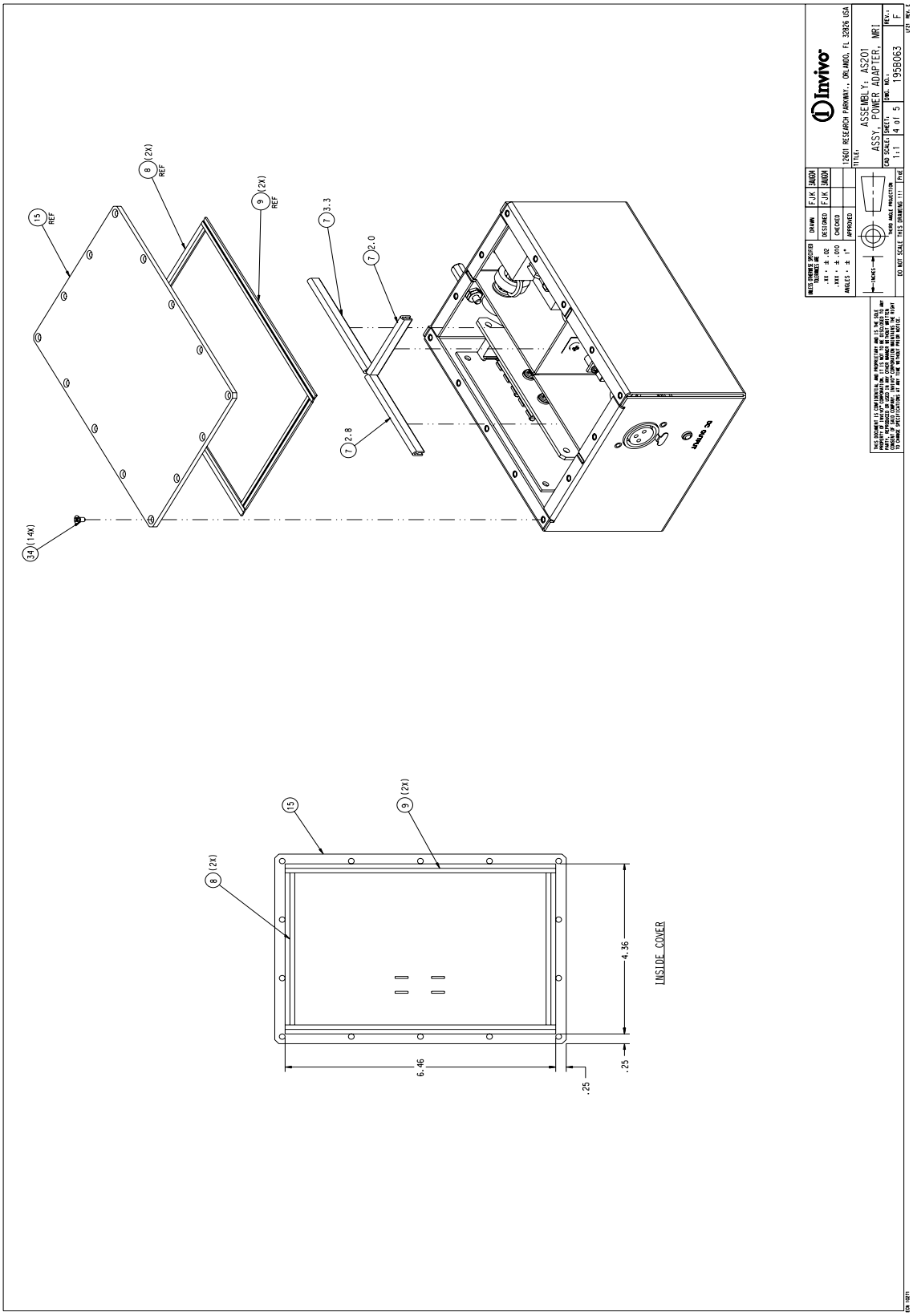
195B063


(8) (2X) REF
(9) (2X) REF
(15) REF
(7) 3.3
(7) 2.0
(7) 2.8
(34) (14X)
(15)
(9) (2X)
(8) (2X)
4.36
6.46
.25
.25
INSIDE COVER
Invivo
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ASSY, POWER ADAPTER, MR1
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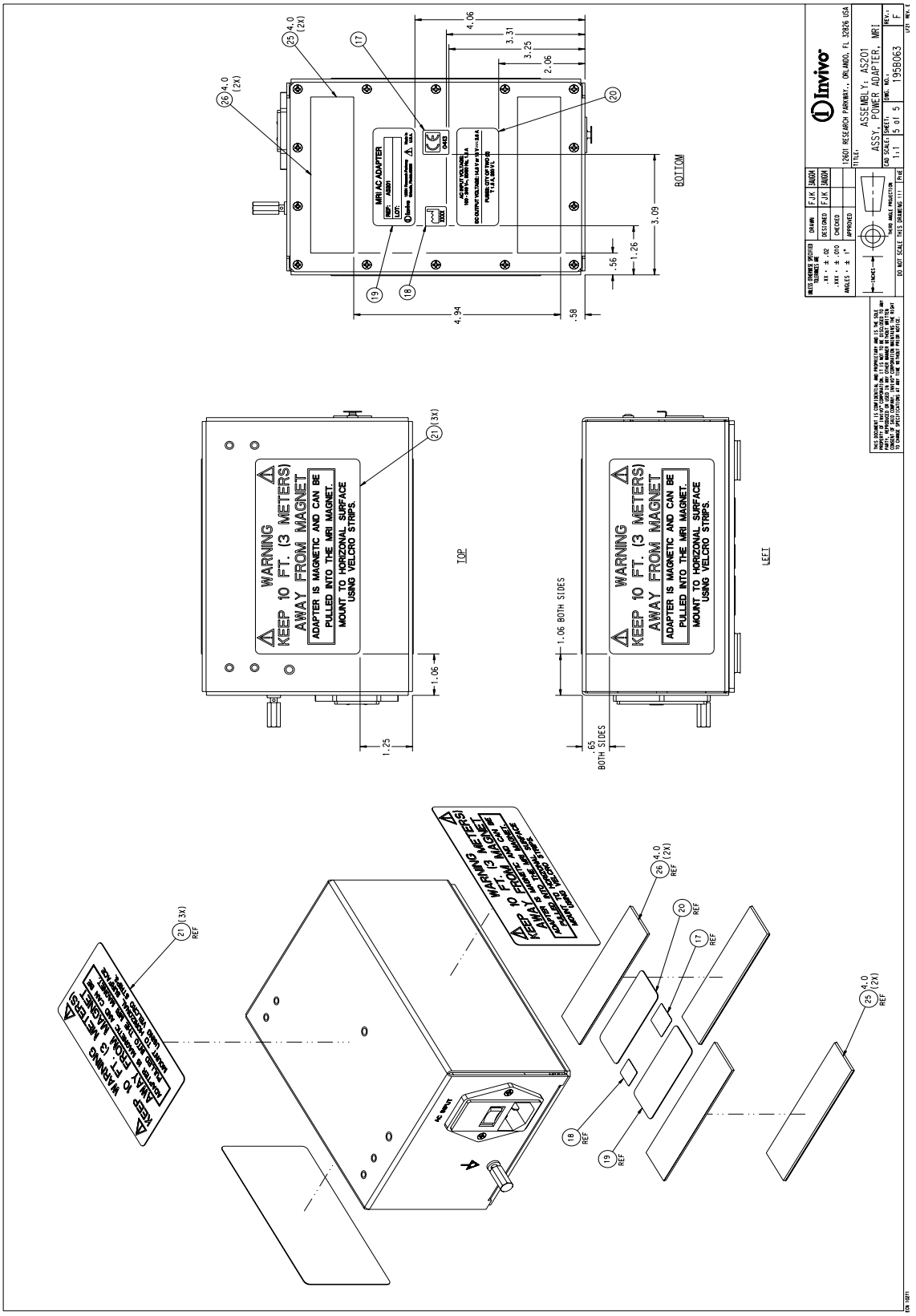
BOTTOM
TOP
LEFT
WARNING
KEEP 10 FT. (3 METERS) AWAY FROM MAGNET
ADAPTER IS MAGNETIC AND CAN BE PULLED INTO THE MRI MAGNET.
MOUNT TO HORIZONAL SURFACE USING VELCRO STRIPS.
MRI AC ADAPTER
Invivo
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ASSEMBLY, AS201
ASSY, POWER ADAPTER, MRI
1958063

REFERENCES

NOTE

A list of reference documents is presented below in the order in which they are cited in the body of this manual, followed by the page number associated with the first occurrence of each reference.

Document Title **Page**

3160 Series MRI Patient Monitor Operations Manual (Invivo Part Number 9569) 1-1

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GLOSSARY

NOTE

A glossary of terms, abbreviations and acronyms is presented below, followed by the page number associated with the first occurrence of each term in the body of the manual.

A

Alternating Current (AC or VAC) - an electric current that reverses its direction at regularly recurring intervals. *[2-2]*

Anesthetic Agent - a gas capable of producing anesthesia. *[1-1]*

B

Battery - a cell or connected group of cells that converts chemical energy into electrical energy by reversible chemical reactions and that may be recharged by passing a current through it in the direction opposite to that of its discharge. *[1-2]*

BPM - beats per minute. *[5-13]*

bps - bytes per second. *[4-5]*

C

Calibrate - to make precise, periodic adjustments for a particular function. *[3-10]*, *[7-1]*

Carbon Dioxide (CO2) - a heavy colorless gas that does not support combustion, dissolves in water to form carbonic acid, and is formed especially in animal respiration and in the decay or combustion of animal and vegetable matter. *[1-1]*

D

DCU - Display Control Unit. *[1-1]*

Desflurane (DES) - an inhalation anesthetic with physical characteristics that provide rapid induction of and recovery from anesthesia. *[5-33]*

Diastolic - related to the dilation of the cavities of the heart during which they fill with blood. *[5-26]*

Digital Multimeter (DMM) - a digital instrument capable of measuring electric current in amperes, the differences in voltage potential between different points of an electrical circuit, and also indicating resistance in ohms directly. *[7-1]*

Digital Signal Processing (DSP) - a category of techniques that analyzes and digitally encodes analog signals. *[1-1]*

Direct Current (DC or Vdc) - an electric current flowing in one direction only and substantially constant in value. *[2-2]*

DS - Direct Sequence. *[4-5]*

DSSS - Direct Sequence Spread Spectrum. *[4-5]*

E

Electrocardiograph (ECG) - an instrument for recording the changes of electrical potential occurring during the heartbeat used especially in diagnosing abnormalities of heart action. *[1-1]*

Electromagnetic Interference (EMI) - an electrical disturbance in a system due to natural phenomena, low-frequency waves from electromechanical devices or high-frequency waves (RFI) from chips and other electronic devices. *[7-12]*

EMI Gasket - a material applied to a joint that is used to reduce or block EMI. *[7-12]*

Enflurane (ENF) - an extremely stable inhalation anesthetic that allows rapid adjustments of anesthesia depth with little change in pulse or respiratory rate. *[5-33]*

F

F.O. - Fiber Optic. *[5-13]*

FHSS - Frequency Hopping Spread Spectrum. *[4-3]*

Fuse - a protective device that is designed to melt, or blow, when a specified amount of current is passed through it. *[3-1]*

G

GigaHertz (GHz) - 1,000,000,000 Hertz. *[1-1]*

H

Halothane (HAL) - a nonflammable, halogenated, hydrocarbon anesthetic that provides relatively rapid induction with little or no excitement. *[5-33]*

I

ID - Identification. *[4-1]*

Industrial, Scientific and Medical (ISM) Band - a part of the radio spectrum that can be used by anybody without a license in most countries. *[4-3]*

Isoflurane (ISO) - a stable, non-explosive inhalation anesthetic, relatively free from significant side effects. *[5-33]*

K

Kilobytes per second (kbps) - 1,000 bps. *[4-5]*

L

Light Emitting Diode (LED) - a semiconductor diode that emits light when a voltage is applied to it and that is used in an electronic display. *[1-4]*

M

Manometer - an instrument (as a pressure gauge) for measuring the pressure of gases and vapors. *[5-21]*

Mean - a value that is computed by dividing the sum of a set of terms by the number of terms. *[5-26]*

Megahertz (MHz) - 1,000,000 Hertz. *[4-5]*

Milliwatt (mW) - 0.001 watt. *[4-5]*

MR - Magnetic Resonance. *[4-1]*

MRI - MR Imaging. *[1-1]*

N

Nitrous Oxide (N2O) - a colorless gas that when inhaled produces loss of sensibility to pain preceded by exhilaration and sometimes laughter--also called laughing gas. *[5-32]*

Non-Invasive Blood Pressure (NIBP) - a means of measuring blood pressure (via an inflatable cuff) without invading the patient's body. *[1-1]*

O

Oxygen (O2) - a colorless, tasteless, odorless gaseous element that is capable of combining with all elements except the inert gases, that is active in the physiological processes, and that is involved especially in combustion. *[3-15]*

P

PCU - Patient Connection Unit. *[1-1]*

Power Supply - a source of electrical energy. *[1-2]*

Processor - the part of a computer system that operates on data. *[1-2]*

R

Recommended Standard 232 (RS232) - a TIA/EIA standard for serial transmission between computers and peripheral devices (modem, mouse, etc.). *[4-5]*

RF - Radio Frequency. *[1-1]*

S

Sevoflurane (SEV) - a halogenated ether for inhalation anesthesia. *[5-33]*

Simulator - a device that enables the operator to reproduce or represent under test conditions phenomena likely to occur in actual performance. *[5-9]*

SS - Spread Spectrum. *[4-5]*

Super VGA (SVGA) - a set of graphics standards that supports 800x600 resolution and a palette of up to 16 million colors. *[3-2]*

Systolic - related to the contraction of the heart by which the blood is forced onward and the circulation maintained. *[5-26]*

T

Transceiver - a radio transmitter-receiver that uses many of the same components for both transmission and reception. *[1-1]*

U

Universal Serial Bus (USB) - a parallel interface for low-speed peripheral devices. *[3-2]*

V

Video Graphics Array (VGA) - a video standard that allows for resolution up to 640x480 with up to 16 colors at a time. *[3-2]*

W

WECG - Wireless ECG. *[1-1]*

WPU - Wireless Processing Unit. *[1-1]*

WSPO2 - Wireless SPO2. *[1-2]*

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